CONVERSION of small HYDRAULIC COTTONSEED OIL MILLS

into HIGHER OIL-YIELDING MILLS

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CONTENTS

CONTENTS (Continued)

CONVERSION OF SMALL HYDRAULIC COTTONSEED OIL MILLS INTO HIGHER OIL-YIELDING MILLS

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SUMMARY

In this study of conversion of the hydraulic type of cottonseed oil mill into more productive plants of the screw-press, prepress-solvent, or direct-solvent type, two general conclusions were reached:

1. When the annual volume of seed crushed is sufficient to show a profit on new investment in conversion to both the prepress-solvent and the direct-solvent type of plant, it is always more profitable to convert to the prepress-solvent type.

2. When volume is sufficient to show a profit on new investment in conversion to both the screw-press and the prepress-solvent type of plant, the profit is always greater in converting to the screw-press type of operation.

For example, conversion of a 100-ton-per-day hydraulic mill, crushing 19,800 tons of seed in a 9-month season, into either type of solvent mill would show a net return on the investment in conversion. The prepress-solvent conversion shows an 11-percent greater increase in total processing cost than the direct-solvent conversion, but the increase in oil revenue is 16 percent greater for the prepress system and the increase in total net revenue is 17 percent greater. Adding the fact that the investment in the prepress system is 3 percent less than in the direct-solvent system, the prepress-solvent system shows a 20-percent greater return per dollar of new investment.

Somewhat similarly, conversion to the screw-press system involves less investment than the prepress-solvent system. Although the total net profit resulting from screw-press conversion is substantially less than the net from the prepress-solvent conversion, it is substantially greater per dollar of new investment.

In the study, computations were made showing the amount of seed necessary to permit a given hydraulic mill to convert to any one of the other three types and, by the conversion, to make specified percentages of return on the new investment. The data on the needed volumes and percentage returns are presented in detail in the body of this report.

The conclusions of the study are based on an analysis of the gains (or losses) in net revenue that could be expected after conversion of 5 widely separated hydraulic mills, with capacities ranging from 50 to 150 tons per day, into alternative types of mills. In this analysis, the mills were made comparable with respect to taxes, insurance, interest on new investment, prices, seed quality, residual oil in meal, and oil quality. No factors except differences in type and size of mill were permitted to affect the gain (or loss) in net revenue.

For each of the 5 hydraulic mills, data were developed to show the expected new investment (and costs), additional current costs, and net returns (or losses) resulting from conversion to screw-press, direct-solvent, or prepress-solvent extraction. Results were calculated for operating seasons varying from 3 to 12 months, with corresponding variations in annual crushes. The analysis of the various practical conversions of these 5 mills, varying in size and in potential length of operating seasons, gave a basis for a more general application of the findings. By further development of the findings, the factors in such conversions were made applicable to any hydraulic mill with a normal capacity between 50 and 150 tons of cottonseed per day.

Prices for new facilities were obtained for the first quarter of 1955. Since then, they have changed appreciably. Changes have also occurred in equipment design for prepress-solvent facilities. Very recently, changes have been made in screw presses which enable them to operate at somewhat higher rates than those used in this report.

THE PROBLEM

In terms of the 1946-49 average, more than half the mills of the cottonseed oil milling industry each crushed under 10,000 tons of seed annually. Only one-fifth crushed over 20,000 tons. During that period, the industry was composed predominantly of hydraulic mills. Beginning in the late 1940's, the direct-solvent process, which yields more oil, was introduced into the industry. This was followed (about 1950) by the prepress-solvent process, which in turn was followed (about 1954) by the high-speed screw press. However, with these changes, more than one-third of the mills in 1955-56 crushed less than 10,000 tons, the average of all mills being about 21,000 tons.

Throughout the period, the changes in type of mill were seldom made for the purpose of reducing cost. Total cost of processing a ton of cottonseed

normally was increased significantly by the change. But the increase in cost of the newer methods was more than offset by the value of the increase in oil yield.

In the analysis, therefore, estimates of the increase in costs constituted only a first step. This was followed by parallel estimates of increase in value of products, or gross revenue. Finally, net revenue estimates were computed. Complications of developing estimates were held to a minimum by restricting calculations to changes in cost and revenue, rather than total cost and revenue.

It is commonly recognized that, for relatively large volumes of seed, it is economical to convert hydraulic mills to any higher oil-yielding type of mills. But many operators are faced with the question, what is the minimum size of mill and the minimum volume of seed required per season to yield an acceptable rate of return on the new investment involved. These requirements may differ greatly with differences in new investment necessary for conversion to different types of mills, and with possible price differentials between the meals from different types of mills.

This study was undertaken to develop information that would serve as a more adequate basis for practical decisions on the conversion of hydraulic mills. To present the results in a uniform way, the additional net revenue resulting from each conversion is stated in terms of revenue per ton of seed and in terms of return per dollar of new investment. In this measurement, it is not necessary to compare total costs and total revenues before and after conversions. It is necessary to consider only (1) the extent to which those costs, affected by conversion, might be changed, and (2) the extent to which revenues might be affected by (a) increase in oil revenue through greater oil yields and (b) change in meal revenue as a result of price differentials.

In line with these facts, no attempt was made to determine the extent to which a mill of a specific size would be better off or worse off after conversion than before. Since an operator already knows the net income (or loss) from his present hydraulic operations, he needs information only on the gains, if any, that may be achieved by conversion in order to decide whether to convert.

APPROACH

Numerous operators of hydraulic mills offered to join in the study. Five widely separated mills were selected whose sizes and characteristics seemed most nearly those needed in order to make the analyses from which general relationships could be derived. Their normal daily capacities were as follows:

Mill	Tons of seed crushed per day
A	150
B	130
C	110
D	75
E	50

For each of these mills, estimates were made of the additional costs and revenues that would result from converting to prepress-solvent, direct-solvent, and screw-press mills. For each screw-press mill, two or more estimates were made, with varying rates of throughput per press, and consequently varying numbers of presses. This was done to determine which number was most economical.

A Two-Stage Study

The study fell into two main stages. The first stage consisted of working out the conversion problem in terms of the particular circumstances of each of the five individual mills--the physical plant, the oil and ammonia content of seed, residual oil in meal, oil quality, property taxes, insurance and wage rates, and prices paid for other operating inputs.

In the second stage of the study, the effect of conversion was estimated in such a way as to avoid peculiarities of individual mills and emphasize the influence of size of mill and annual tonnage of seed crushed. For a mill of any given size, of course, annual tonnage and length of operating season at normal capacity are alternate expressions of volume of business.

A few examples pinpoint the essential differences between the procedures used in each stage. If one hydraulic mill were leaving 6 percent of oil in the meal, as compared to 5 percent for another mill of equal size, then the first could expect a greater oil gain and revenue gain from conversion. Therefore, a smaller annual crush would be required to support the additional investment needed to convert the first mill. For the individual mill, therefore, it was essential to work out the conversion problem in terms of its residual oil in meal. To achieve industrywide comparisons by size of mill, however, variation of residual oil in meal should be eliminated. This was done by using the average residual oil for the mills studied. Similarly, averages of oil and seed qualities were used. Also, the second stage assumed uniform rates for (1) property taxes, insurance, and interest, (2) prices for operating inputs, and (3) oil and meal sold.

The amount and kinds of new equipment necessary for conversion varied among the 5 specific mills because of differences in old equipment, some of which could be utilized in the converted mill.

In conversion to a 3-screw-press mill, new investment required was actually less for the 110-ton mill (mill C) than for the 75-ton mill (mill D). In stage 2, such irregularities in new investment requirements were eliminated for each size of mill, however, by computing from the data for the 5 mills mathematical trends representing normal (average) relationships between (1) annual tonnage of seed crushed (and thus length of season) and (2) the rate that added net revenue could pay on the new investment required.

In developing data for the study, account was taken of any physical improvements which an operator would seriously consider making in the course of conversion, but which could be made without conversion. Such improvements were omitted as costs of conversion. For example, some cooperating mills produced only slab cake and did not have a meal grinding department. Because such equipment is the same in hydraulic and screw-press mills, however, it may be installed without conversion, and it was not here considered a part of the conversion problem. All 5 hydraulic mills were treated as producers of ground meal, and the annual fixed charges on investment in meal equipment were considered a part of the cost of the hydraulic operation. In like manner, the labor and power needed for meal processing operations were added to the slab-cake mills before calculating the extent to which any conversion would change operating costs. The price differential between slab-cake and meal was excluded from the calculations in this report.

It would have been possible to improve the boiler efficiencies and efficiencies in overall heat utilization of some of the 5 mills without conversion. Thus the gains therefrom should not be credited to conversion. As a practical solution, standard boilers and the same overall efficiency of fuel utilization were used for all 5 mills.

One mill was only partially electrified, but would be completely electrified in the course of conversion. The individual report to this operator worked out what the expected power, fuel, water and steam consumption of the present mill would be if it were completely electrified, then used these adjusted figures in determining the extent to which conversion would change the mill's power, fuel, and water requirements. In this report, no reference is made to this mill's power, fuel, and requirements under partial electrification.

After working out the conversion problem for the 5 hydraulic mills along the lines just described, relationships were developed between their sizes and the new investments needed for converting them into alternative types of mills. Corresponding relationships were then developed for fixed annual charges on new investment, and also the changes in current costs per ton of seed. From these relationships were calculated annual crushes which were necessary to yield net returns at specific rates, ranging from 5 to 20 percent on new investment, in converting any hydraulic mill into screw-press, direct-, and prepress-solvent mills.

Investment Requirements and Salvage Value of Discarded Facilities

The initial cost of new facilities necessary for any conversion is equal to the total cash outlays for their purchase and installation minus the net salvage value of discarded facilities. All operators participating in this study estimated that salvage value would approximately equal dismantling cost, leaving a net salvage value of zero. As this judgment was shared by many other persons familiar with the industry, it was assumed that the initial cost of any conversion would equal the total cash outlays required for the purchase and installation of facilities. In this report, such initial cost is called the "new investment requirements" of converted mills.

Assumptions Concerning Method of Construction

The amount of investment required for new facilities is significantly affected by the management of the conversion job. Total costs of construction will be highest if the whole construction job is done under one general contract. Under such an arrangement, the contractor assumes all the risks of weather, work stoppages, price increases, and the like; consequently, he must add a contingency to his estimate of the cost of the job to him to insure against possible losses. Of course, he includes a sum in the contract as payment for his own management. In some cases, the mill personnel can perform all of the different parts of the job and this usually results in lowest cost.

In this study, it was assumed:

(1) Costs of most engineering services were included in the cost of the equipment; some services, however, were purchased by the management of the mill.

(2) Purchasing was performed by the suppliers of most of the equipment or by the management of the mill, or both.

(3) All construction was performed by local contractors engaged and directed by the management.

(4) Machinery was placed and connected by the mill personnel or by local firms engaged by the management of the mill.

(5) Generally speaking, all costs for installing machinery were estimated to be equal to 22.5 percent of the f.o.b.-factory cost. These estimates were made in such a way as to include contractor's overhead and payment for the contractor's own management.

Price and Equipment Changes

Most prices for new machinery were those in effect during the first quarter of 1955. Since then, these prices have undergone appreciable change,

and this fact should be kept in mind in reviewing the estimates for conversion investment requirements in this study. Changes have occurred also in equipment design, particularly with respect to prepress-solvent facilities for cottonseed processing. Very recently, changes have similarly been made in screw presses which enable them to operate at somewhat higher rates than any of those described in this report.

Throughput, Oil Yield, and Power Consumption of Modern Screw Presses

Modern screw presses are capable of operating over a wide range of throughputs. With its motor loaded to its rated capacity, the lower the throughput of a screw press the more electric power it uses per ton of seed, but the more oil it extracts per ton. In converting a mill of any given capacity, the question arises what number of presses will yield the greatest amount of new net revenue per ton of seed and per dollar of new investment.

To handle this question, it was necessary to estimate how oil yields and electric power consumption vary with throughputs per press. The nature of these relationships is discussed in detail in appendix I.

NEW INVESTMENT REQUIREMENTS

The expected new investment requirements for each conversion are shown in table 1. This table shows, for each conversion, total estimated installed costs of all needed new equipment and facilities as well as all new buildings or building modifications.

Tables 21 through 23 of appendix II show a detailed breakdown of these totals into outlays for specified items of machinery, equipment, buildings, and other facilities. For each item, there is given the initial cost of materials, installation, and equipment, as well as its expected years of useful life, depreciation rate, and annual depreciation charge. These tables are also accompanied by general explanations of the need for each item in the conversion.

ANNUAL CHARGES ON NEW CAPITAL

Fixed annual charges on conversion investments are depreciation, interest, insurance, and property taxes.

Depreciation

Depreciation rates for the various facilities are shown in tables 21 through 23 of appendix II.

Table 1.--Expected new investment required in converting 5 specified hydraulic cottonseed oil mills into alternative types of mills, 1955-56

Mill	Normal daily crushing capacity	Daily throughput per screw press	New investment: Total 1/	New investment: Per ton of daily crushing capacity
	Tons	Tons	Dollars	Dollars
Mill A--Hydraulic mill converting to:				
Screw press--				
4 presses	150	37.50	278,370	1,856
5 presses	150	30.00	311,470	2,076
6 presses	150	25.00	344,570	2,297
Direct solvent	150		532,070	3,547
Prepress solvent	150		473,250	3,155
Mill B--Hydraulic mill converting to:				
Screw press--				
3 presses	130	43.33	222,620	1,712
4 presses	130	32.50	256,540	1,973
5 presses	130	26.00	296,670	2,282
Direct solvent	130		509,740	3,921
Prepress solvent	130		495,100	3,808
Mill C--Hydraulic mill converting to:				
Screw press--				
3 presses	110	36.67	173,630	1,578
4 presses	110	27.50	205,490	1,868
Direct solvent	110		407,990	3,709
Prepress solvent	110		431,160	3,920
Mill D--Hydraulic mill converting to:				
Screw press--				
2 presses	75	37.50	146,880	1,958
3 presses	75	25.00	179,020	2,387
Direct solvent	75		392,120	5,228
Prepress solvent	75		371,070	4,948
Mill E--Hydraulic mill converting to:				
Screw press--				
1 press	50	50.00	80,590	1,612
2 presses	50	25.00	112,450	2,249

1/ From tables 21, 22, and 23.

A uniform amount of depreciation year by year over the life of the facilities was assumed. For example, if the useful life of a facility was 20 year, its annual depreciation charge was calculated as 5 percent of its initial investment value or cost. Useful lives of facilities are difficult to estimate accurately. The estimates used in this report are based on those used by the Bureau of Internal Revenue for tax evaluation of facilities similar to those in this study.

Interest

A charge of 5 percent a year was made on all new investment, irrespective of whether the funds were owned or borrowed. This is a rate which operators quite usually would expect to pay if they borrowed the investment funds and also about the minimum rate which they would expect from their own funds before they would invest them in any conversion.

Insurance

The effect of conversions on annual insurance charges was calculated through the following steps.

All 5 hydraulic mills were placed on a comparable basis with respect to insurance costs by using an average insurance rate.

The values of mills for insurance purposes are known in the industry as "appraised values"--certified statements from the mills to State rating bureaus for use in determining the insurance ratings of mills. Such values for all hydraulic mills are shown in table 2. The values shown for converted mills are the appraised values of all old facilities retained after conversion plus the investment in all new items to be insured. (The investment cost of new facilities is equivalent to their appraised value. Some facilities, such as a water main, would not be insured.)

In determining the appraised value of the facilities retained, it was necessary to subtract the appraised value of all facilities discarded in course of conversion from the total appraised value of the hydraulic mill.

In no cases did the appraised values of the mills contain enough detail that the values of facilities to be discarded could be estimated directly. An appraised value of a mill usually included as one item the "mill group." This was all of the main part of the mill which was under one roof. The mill group usually included the main mill building, nearly all of the processing machinery, and the boiler house.

All of the building sections and all of the machinery in the mill group bore the same insurance rate although in some cases the rate on the building was not the same as the rate on the machinery.

Table 2.--Expected change in annual insurance charges in converting 5 specified hydraulic cottonseed oil mills into alternative types of mills, 1955-56

Mill	Appraised value 1/	Cost per $100 of insurance: Fire	Extended coverage	Total	Premiums 2/	Increase in premiums
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Mill A (150 tons per day):						
Hydraulic	932,700	0.878	0.255	1.133	9,511	
Screw press--						
4 presses	1,035,000	.822	.248	1.070	9,967	456
5 presses	1,068,100	.822	.248	1.070	10,286	775
6 presses	1,101,200	.822	.248	1.070	10,605	1,094
Direct solvent	1,282,300	.866	.188	1.054	12,164	2,653
Prepress solvent	1,204,000	.850	.203	1.053	11,410	1,899
Mill B (130 tons per day):						
Hydraulic	791,900	.878	.255	1.133	8,075	
Screw press--						
3 presses	944,100	.822	.248	1.070	9,092	1,017
4 presses	976,200	.822	.248	1.070	9,401	1,326
5 presses	1,014,600	.822	.248	1.070	9,771	1,696
Direct solvent	1,227,500	.866	.188	1.054	11,644	3,569
Prepress solvent	1,229,600	.850	.203	1.053	11,653	3,578
Mill C (110 tons per day):						
Hydraulic	606,200	.878	.255	1.133	6,181	
Screw press--						
3 presses	676,800	.822	.248	1.070	6,518	337
4 presses	708,700	.822	.248	1.070	6,825	644
Direct solvent	899,800	.866	.188	1.054	8,536	2,355
Prepress solvent	923,000	.850	.203	1.053	8,747	2,566
Mill D (75 tons per day):						
Hydraulic	360,000	.878	.255	1.133	3,671	
Screw press--						
2 presses	417,900	.822	.248	1.070	4,024	353
3 presses	450,000	.822	.248	1.070	4,334	663
Direct solvent	660,800	.866	.188	1.054	6,268	2,597
Prepress solvent	661,400	.850	.203	1.053	6,268	2,597
Mill E (50 tons per day):						
Hydraulic	90,000	.878	.255	1.133	918	
Screw press--						
1 press	143,200	.822	.248	1.070	1,379	461
2 presses	175,000	.822	.248	1.070	1,685	767

1/ The insurance appraisal of any hydraulic mill producing slab-cake was adjusted upward to include equipment needed for meal grinding and handling.
2/ Assumes the value of insurance carried is equivalent to 90 percent of the appraised values.

The values of facilities to be discarded were estimated in a manner which can be explained most easily by an example. Assume the appraised value of a mill group is $100,000. Using 1949-50 investment costs, assume the replacement cost of this mill group is estimated to be $200,000 and the replacement cost of facilities to be discarded in conversion is estimated to be $50,000. The replacement cost of discarded facilities is thus 25 percent of the appraised value of the mill group, which is $25,000. The appraised value of the converted mill is then $100,000 minus $25,000, plus the appraised value of unchanged facilities, plus the cost of all new facilities.

For each type of conversion, an average rate was used for the several sizes of mills. These averages (table 2) were worked out in terms of the rates for individual facilities used by State rating bureaus.

As the amount of insurance carried by mills is usually equivalent to 90 percent of their appraised value, the expected effect of conversions on insurance charges is based on this percentage.

Taxes

For convenience of computation, taxes were converted to percentages of insurance "appraised values." Taxes paid by the 5 hydraulic mills averaged 0.67 percent of their appraised values. This percentage was applied to the appraised value of any converted mill, as indicated in table 3.

Total Fixed Annual Charges

Table 4 shows the expected fixed annual charges for each of the conversions. These total charges will be unaffected by variations in operation of the mill.

A basic question here is what annual crush will pay the "fixed" charges and yield any specified rate of net return on the new investment in conversion.

Assuming an average of 22 working days of 24 hours each per month, table 5 shows, on a per-ton-of-seed basis, the effect of size of annual crush on the fixed annual charges of conversion.

CHANGE IN CURRENT OPERATING COSTS

The current operating costs which are affected by a change in type of mill are labor, electric power, fuel, maintenance and repairs, laboratory services, press cloth, hexane soldent, soapstock, and water.

Labor

The extent to which alternative conversions for each mill were expected to reduce total man-hours and labor costs is shown in table 6. The number of

Table 3.--Expected changes in annual property taxes in converting 5 specified hydraulic cottonseed oil mills into alternative types of mills, 1955-56

Mill	Appraised value	Taxes 1/	Increase in taxes
	Dollars	Dollars	Dollars
Mill A (150 tons per day):			
Hydraulic	932,700	6,249	
Screw press--			
4 presses	1,035,000	6,935	686
5 presses	1,068,100	7,156	907
6 presses	1,101,200	7,378	1,129
Direct solvent	1,282,300	8,591	2,342
Prepress solvent	1,204,000	8,067	1,818
Mill B (130 tons per day):			
Hydraulic	791,900	5,306	
Screw press--			
3 presses	944,100	6,325	1,019
4 presses	976,200	6,541	1,235
5 presses	1,014,600	6,798	1,492
Direct solvent	1,227,500	8,224	2,918
Prepress solvent	1,229,600	8,238	2,932
Mill C (110 tons per day):			
Hydraulic	606,200	4,062	
Screw press--			
3 presses	676,800	4,535	473
4 presses	708,700	4,748	686
Direct solvent	899,800	6,029	1,967
Prepress solvent	923,000	6,184	2,122
Mill D (75 tons per day):			
Hydraulic	360,000	2,412	
Screw press--			
2 presses	417,900	2,800	388
3 presses	450,000	3,015	603
Direct solvent	660,800	4,427	2,015
Prepress solvent	661,400	4,431	2,019
Mill E (50 tons per day):			
Hydraulic	90,000	603	
Screw press--			
1 press	143,200	959	356
2 presses	175,000	1,173	570

1/ Taxes are estimated to be 0.67 percent of appraised values.

Table 4.--Expected annual fixed charges on new investment in converting 5 specified hydraulic cottonseed oil mills into alternative types of mills, 1955-56

Mill	Normal daily crushing capacity	New investment 1/	Depreciation 2/	Interest 3/	Insurance 4/	Taxes 5/	Total fixed charges
	Tons	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.
Mill A--Hydraulic mill converting to:							
Screw press--							
4 presses	150	278,370	11,700	13,918	456	686	26,760
5 presses	150	311,470	13,024	15,574	775	907	30,280
6 presses	150	344,570	14,348	17,229	1,094	1,129	33,800
Direct solvent	150	532,070	21,921	26,604	2,653	2,342	53,520
Prepress solvent ..	150	473,250	20,214	23,663	1,899	1,818	47,594
Mill B--Hydraulic mill converting to:							
Screw press--							
3 presses	130	222,620	8,720	11,131	1,017	1,019	21,887
4 presses	130	256,540	10,049	12,827	1,326	1,235	25,437
5 presses	130	296,670	11,628	14,834	1,696	1,492	29,650
Direct solvent	130	509,740	20,499	25,487	3,569	2,918	52,473
Prepress solvent ..	130	495,100	19,848	24,755	3,578	2,932	51,113
Mill C--Hydraulic mill converting to:							
Screw press--							
3 presses	110	173,630	7,095	8,682	337	473	16,587
4 presses	110	205,490	8,370	10,275	644	686	19,975
Direct solvent	110	407,990	16,476	20,400	2,355	1,967	41,198
Prepress solvent ..	110	431,160	17,633	21,558	2,566	2,122	43,879
Mill D--Hydraulic mill converting to:							
Screw press--							
2 presses	75	146,880	6,080	7,344	353	388	14,165
3 presses	75	179,020	7,366	8,951	663	603	17,583
Direct solvent	75	392,120	15,938	19,606	2,597	2,015	40,156
Prepress solvent ..	75	371,070	15,199	18,554	2,597	2,019	38,369
Mill E--Hydraulic mill converting to:							
Screw press--							
1 press	50	80,590	3,342	4,030	461	356	8,189
2 presses	50	112,450	4,616	5,623	767	570	11,576

1/ From table 1. 2/ From tables 21, 22, and 23. 3/ Equal to 5 percent of new investment. 4/ From table 2. 5/ From table 3.

Table 5.--Fixed charges per ton of cottonseed on new investment in converting 5 specified hydraulic cottonseed oil mills into alternative types of mills, by size of annual crush, 1955-56

Mill and tons crushed annually 1/	Normal daily crushing capacity	Fixed charges 2/							
		Screw-press mill with-- 3/						Direct-solvent mill	Prepress-solvent mill
		1 press	2 presses	3 presses	4 presses	5 presses	6 presses		
	Tons	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Mill A:									
39,600	150				0.68	0.76	0.85	1.35	1.20
29,700	150				.90	1.02	1.14	1.80	1.60
19,800	150				1.35	1.53	1.71	2.70	2.40
9,900	150				2.70	3.06	3.41	5.41	4.81
Mill B:									
34,300	130			0.64	.74	.86		1.53	1.49
25,700	130			.85	.99	1.15		2.04	1.99
17,200	130			1.27	1.48	1.72		3.05	2.97
8,600	130			2.55	2.96	3.45		6.10	5.94
Mill C:									
29,000	110			.57	.69			1.42	1.51
21,800	110			.76	.92			1.89	2.01
14,500	110			1.14	1.38			2.84	3.03
7,300	110			2.27	2.74			5.64	6.01
Mill D:									
19,800	75		0.72	.89				2.03	1.94
14,900	75		.95	1.18				2.70	2.58
9,900	75		1.43	1.78				4.06	3.88
5,000	75		2.83	3.52				8.03	7.67
Mill E:									
13,200	50	0.62	.83						
9,900	50	.83	1.17						
6,600	50	1.24	1.75						
3,300	50	2.48	3.51						

1/ Crushes for each mill represent operating seasons of 12, 9, 6, and 3 months, respectively, assuming an average of 22 working days of 24 hours each per month. 2/ Total fixed annual charges per mill in table 4 divided by size of annual crush. 3/ Throughput per press per 24 hours is equal to the normal daily crushing capacity divided by the number of presses.

Table 6.--Expected change in labor requirements and costs in converting 5 specified hydraulic cottonseed oil mills into alternative types of mills, 1955-56

Mill	Normal daily crushing capacity	Man-hours eliminated per day 1/: Meal cook	Former puller	Pan shover	Cake puller	Cake stripper	Total	Per ton of seed	Reduction in wage per day 2/	Man-hours added per day 1/: Screw-press operator	Extractor operator	Foreman	Total	Per ton of seed	Increase in wage per day 3/	Net reduction in man-hours per day	Net reduction in labor cost per day: Wage bill 4/	Welfare cost 5/	Total	Per ton of seed
	Tons	No.	No.	No.	No.	No.	No.	No.	Dol.	No.	No.	No.	No.	No.	Dol.	No.	Dol.	Dol.	Dol.	Dol.
Mill A:																				
Hydraulic mill converting to:																				
Screw press 6/ ...	150	24	24	72	48	24	192	1.28	199.68	24			24	0.16	26.40	168	173.28	13.05	186.33	1.24
Direct solvent ...	150	24	24	72	48	24	192	1.28	199.68		24	24	48	.32	57.60	144	142.08	10.70	152.78	1.02
Prepress solvent .	150	24	24	72	48	24	192	1.28	199.68	7/24	24	24	72	.48	84.24	120	115.44	8.69	124.13	.83
Mill B:																				
Hydraulic mill converting to:																				
Screw press 6/ ...	130	24	24	48	48	24	168	1.29	174.72	24			24	.18	26.40	144	148.32	11.17	159.49	1.23
Direct solvent ...	130	24	24	48	48	24	168	1.29	174.72		24	24	48	.37	57.60	120	117.12	8.82	125.94	.97
Prepress solvent .	130	24	24	48	48	24	168	1.29	174.72	7/24	24	24	72	.55	84.24	96	90.48	6.81	97.29	.75
Mill C:																				
Hydraulic mill converting to:																				
Screw press 6/ ...	110	24	24	48	48	24	168	1.53	174.72	24			24	.22	26.40	144	148.32	11.17	159.49	1.45
Direct solvent ...	110	24	24	48	48	24	168	1.53	174.72		24	24	48	.44	57.60	120	117.12	8.82	125.94	1.14
Prepress solvent .	110	24	24	48	48	24	168	1.53	174.72	7/24	24	24	72	.65	84.24	96	90.48	6.81	97.29	.88
Mill D:																				
Hydraulic mill converting to:																				
Screw press 6/ ...	75	24	24	32	24	24	128	1.71	133.12	24			24	.32	26.40	104	106.72	8.04	114.76	1.53
Direct solvent ...	75	24	24	32	24	24	128	1.71	133.12		24	24	48	.64	57.60	80	75.52	5.69	81.21	1.08
Prepress solvent .	75	24	24	32	24	24	128	1.71	133.12	7/24	24	24	72	.96	84.24	56	48.88	3.68	52.56	.70
Mill E:																				
Hydraulic mill converting to:																				
Screw press 6/ ...	50		24	24		72	120	2.40	124.80	24			24	.48	26.40	96	98.40	7.41	105.81	2.12

1/ The number of men represented by the man-hours per day depends on the number of shifts per day.
2/ Based on an average hourly wage rate of $1.04 for all mills.
3/ Based on an average hourly wage rate of $1.10 for labor added in the screw-press conversions, $1.20 per hour for the direct-solvent conversions, and $1.17 for the prepress-solvent conversions.
4/ Total wage bill reduction minus total addition to wage bill.
5/ 7.53 percent of net reduction in wages to cover saving of insurance for workmen's compensation, general liability, and unemployment insurance.
6/ For a given daily capacity, the man-hours eliminated or added is the same irrespective of the number of presses in the converted mill.
7/ Prepress operator.

men represented by these man-hours would depend on the number of shifts per day.

Any conversion would eliminate some jobs but would add others. First, all hydraulic press room labor would be eliminated. This labor was greatest per ton of seed in the smallest mills. Thus, net labor reduction per ton of seed was greatest for the smaller mills.

Second, some of the mills had a boiler operator who would be eliminated by any conversion due to the installation of an automatically fired boiler. The installation of this type of boiler could be accomplished, however, without conversion; 1/ therefore, the elimination of the boiler operator is not shown in table 6.

Third, some of the mills produced only slab-cake. No converted mill can produce slab-cake; the addition of a meal-grinding and loading operation can be made, however, as a part of the hydraulic process. For this reason, the labor force of the two mills producing slab-cake was expanded by the amount needed for meal grinding and loading before calculating the number of man-hours to be eliminated or added by conversion.

Fourth, only one screw-press operator had to be added for each screw-press conversion, although the number of possible screw presses varied from 1 for the smallest mill to 6 for the largest. Thus, screw-press operating labor for the 150-ton mill was 0.16 man-hour per ton of seed as compared with 0.48 man-hour for the 50-ton mill. In the two largest mills, it was estimated that 6 additional man-hours would be needed for the screw-press room, but this could be absorbed by the separation room operator or by the yard and cleanup crew. In the other 3 mills, it was assumed that if the screw-press operator occasionally needed extra help, as in cleaning filter presses, he could get it from the meal crew or some other source--the yard and cleanup crew, for example. For safety reasons, some States require at least 2 men in the screw-press room. This study was governed, however, only by the workload of the job.

Fifth, for each of the direct-solvent conversions, 1 extractor-operator and 1 foreman-operator were added. Preparation would not require constant attention, and in every mill the preparation department was situated so that it could be operated either by personnel from adjacent departments or by the foreman-operator of the solvent-extraction department. The foreman-operator would coordinate the preparation and extraction operations, assist the extractor-operator when needed, and oversee the storage of meal when the meal crew was not on duty. The presence of the foreman-operator would decrease the potential hazard accompanying the use of only 1 man in the solvent-extraction department.

For all the prepress-solvent conversions, 1 prepress operator, 1 extractor-operator, and 1 foreman were added. The foreman would coordinate the operations and contribute to the safety of the solvent-extraction department.

1/ Tables 21 through 23 in the appendix do show investment for a new boiler wherever the capacity of the present boiler was not enough to meet the needs of a converted mill.

Sixth, in computing net savings in labor cost, the wage rates of labor eliminated and the expected wage rates of labor added were each averaged for the 5 mills.

By reducing total labor the converted mills would not only reduce their wage bill but would also reduce their welfare costs, such as insurance for workmen's compensation, general liability, social security, and unemployment. These vary somewhat among the cotton-producing States. Social security and unemployment insurance was 3 percent of the wage bill. Other welfare costs averaged $4.72 per $100 of payroll for each type of solvent mill and $4.53 for hydraulic and screw-press mills. 2/ As the difference of 19 cents amounts to less than 1 cent per ton of seed, the lower figure was used for all conversions.

Electric Power

The extent to which alternative conversions of each hydraulic mill were expected to increase or decrease present electric power costs is shown in table 7.

In most electric power rate schedules, power costs are based on two factors: (1) Kilowatt hours and (2) billing demand (other terms also are used). The billing demand perhaps most frequently represents the average kilowatt load during one or more 15-minute intervals in which the load is greatest during the billing period.

Part of the variation in power costs among mills is due to differences in the power rates that they pay. In computing the effect of conversions on power costs of all the mills, a uniform rate of 1.1 cents per kilowatt-hour was used. This was the average paid by 78 cottonseed oil mills during 1954, according to a recent survey of the industry. 3/ Using this average rate, the kilowatt hour data but not the demand data in table 7 affected the cost. The estimates of power demand were included in the table because they enable one to determine the effect of conversion on power costs under any particular rate schedule.

The power cost of mills producing slab-cake was adjusted for meal grinding and loading before calculating the effect of any conversion on power costs.

Gins were associated with some of the mills, but in calculating effects of conversion, power for gin operation was eliminated from that of mill operations, except for one instance where it was negligible.

2/ Brewster, John M. Comparative Economies of Different Types of Cottonseed Oil Mills and Their Effects on Oil Supplies, Prices, and Returns to Growers. U. S. Dept. Agr., AMS. MRR No. 54. 239 pp., illus. 1954.

3/ It is recognized that the cost per kilowatt-hour consumed would be slightly less for the mills using the most power, because rate schedules are based in part on total power used. However, this difference was ignored, as it was not enough to alter appreciably the results shown in table 7.

Table 7.--Expected changes in electric power requirements and costs in converting 5 specified hydraulic cottonseed oil mills into alternative types of mills, 1955-56

Mill	Daily throughput per screw press	Power consumption: Operating group affected by conversion: Continuous producing operations group 1/: Screw-press mills: Pressing 2/	Others 3/	Total	Other mills	Meal handling 4/	Delinting and miscellaneous operations group 5/	Total	Average of monthly billing demands: Continuous producing operations group 1/ 6/	Delinting and miscellaneous operations group 5/	Total	Cost per ton of seed: Total 7/	Increase	Decrease
	Tons	Kw.-hr.	Kw.-hr.	Kw.-hr.	Kw.-hr.	Kw.-hr.	Kw.-hr.	Kw.-hr.	Kw.	Kw.	Kw.	Dol.	Dol.	Dol.
Mill A (150 tons per day)														
Present hydraulic					36	7	62	105	225	561	786	1.155		
Screw press--														
4 presses	37.50	43	44	87		3	62	152	544	561	1,105	1.672	0.517	
5 presses	30.00	49	44	93		3	62	158	581	561	1,142	1.738	.583	
6 presses	25.00	51	44	95		3	62	160	594	561	1,155	1.760	.605	
Direct solvent					32	3	62	97	200	561	761	1.067		0.088
Prepress solvent					56	3	62	121	350	561	911	1.331	.176	
Mill B (130 tons per day)														
Present hydraulic					36	7	74	117	195	548	743	1.287		
Screw press--														
3 presses	43.33	38	44	82		3	74	159	444	548	992	1.749	.462	
4 presses	32.50	49	44	93		3	74	170	503	548	1,051	1.870	.583	
5 presses	26.00	51	44	95		3	74	172	514	548	1,062	1.892	.605	
Direct solvent					32	3	74	109	173	548	721	1.199		.088
Prepress solvent					56	3	74	133	303	548	851	1.463	.176	
Mill C (110 tons per day)														
Present hydraulic					36	7	57	100	165	391	556	1.100		
Screw press--														
3 presses	36.67	44	44	88		3	57	148	403	391	794	1.628	.528	
4 presses	27.50	50	44	94		3	57	154	431	391	822	1.694	.594	
Direct solvent					32	3	57	92	147	391	538	1.012		.088
Prepress solvent					56	3	57	116	256	391	647	1.276	.176	
Mill D (75 tons per day)														
Present hydraulic					36	7	52	95	113	276	389	1.045		
Screw press--														
2 presses	37.50	43	44	87		3	52	142	272	276	548	1.562	.517	
3 presses	25.00	51	44	95		3	52	150	297	276	573	1.650	.605	
Direct solvent					32	3	52	87	100	276	376	.957		.088
Prepress solvent					56	3	52	111	175	276	451	1.221	.176	
Mill E (50 tons per day)														
Present hydraulic					36	7	41	84	75	165	240	.924		
Screw press--														
1 press	50.00	32	44	76		3	41	120	158	165	323	1.320	.396	
2 presses	25.00	51	44	95		3	41	139	198	165	363	1.529	.605	

1/ Operations include conveying seed from storage, cleaning seed, hulling and separating delinted seed, rolling, cooking, and oil extraction. 2/ From figure 12. 3/ From table 8. 4/ This operation was added to slab-cake mills before calculating effect of conversions on present hydraulic power requirements and costs. In Marketing Research Report No. 54, USDA, February 1954, power was estimated to be 7.5 kilowatt-hours per ton of seed for hydraulic meal grinding and pelleting when the meal yield is 1,000 pounds per ton of seed. This figure was rounded to 7 kilowatt-hours because meal yield was somewhat less than 1,000 pounds per ton of seed. The 3 kilowatt-hours per ton of seed for the screw-press and direct- and prepress-solvent processes was based on data from a machinery manufacturer. 5/ Includes delinting seed, seed unloading, seed cooling, and meal processing. Delinting seed includes operating the delinters, the flue system for collecting lint, the lint cleaners, and the lint-baling press. 6/ Total continuous producing power consumption x normal daily crushing capacity/24 hours per day. 7/ Based on an average cost of 1.1 cents per kilowatt-hour consumed, estimated from data reported for the 1954 calendar year by 78 cottonseed oil mills.

Some hydraulic mills were driven partially by steam engines. Before computing the effects of conversion in such a case, electrical energy requirements were raised to what they would have been if the mill were completely electrified.

Power Consumption

Power consumption was broken into two major categories, each of which was again broken into two, as follows:

I. Operating group affected by conversion

   A. Continuous producing operations group
   B. Meal processing

II. Operating group <u>not</u> affected by conversion

   A. Delinting
   B. Miscellaneous

Class I A included: Conveying seed from storage, cleaning seed, hulling and separating delinted seed, rolling meats, cooking meats, and extracting oil. Meal processing includes grinding, screening (for solvent processes), conveying to and from storage, bagging, and any other operations which might be performed on meal or cake. Not every operation in the group was affected by conversion, but the form of data available made it more practical to treat the whole group. The results were not affected by this choice. Delinting (II A) includes: Operation of the delinters, the flue system for collecting lint, lint cleaners, and lint-baling press. Miscellaneous power uses (II B) includes: Seed unloading, seed ventilating and cooling, lighting the mill, and miscellaneous uses.

Estimates of power consumption by hydraulic mills for the continuous producing operations group (I A) and for meal processing (I B) were available from earlier work. The estimates were: 36 kilowatt-hours per ton of seed for the former class, and 7.5 kilowatt-hours for the latter, assuming the seed processed was such as to yield 1,000 pounds of meal per ton of seed. 4/ The figure for meal processing was rounded to 7 kilowatt-hours.

Mill D is arbitrarily selected here to illustrate the steps taken in breaking down the power consumption and power demand into their components. The same steps apply to any other mill.

As mill D, processing 75 tons of seed per day, used about 95 kilowatt-hours of power per ton of seed, the use of 36 kilowatt-hours for class I A and 7 kilowatt-hours for class I B indicated a consumption of 52 kilowatt-hours for delinting (II A), plus miscellaneous operations (II B).

4/ See footnote 2.

In screw-press mills, to which the hydraulics might be converted, power required by the presses was estimated to vary for different throughputs per press, whereas all other operations corresponding to class I A for hydraulic mills would have a constant power requirement which was estimated to be of 44 kilowatt-hours per ton of seed (table 8). The presses were here treated separately in order to give consideration to their variation in power use with variation in throughput.

Table 8.--Estimated kilowatt-hour requirements per ton of cottonseed in screw-press cottonseed oil mills for all producing operations except pressing

Mill operation	Kilowatt-hours 1/
	Number
Cleaning seed	4.5
Hulling seed and separating meats from hulls	7.0
Rolling meats	8.0
Cooking meats	12.0
Lighting	2.5
Miscellaneous pressroom	3.0
Conveyors	7.0
Total	44.0

1/ Based on horsepower of electric motors and amperage readings of motors in actual mills.

Power consumption for meal processing (I B), in the converted mill was estimated to be 3 kilowatt-hours per ton of seed, in contrast with 7 kilowatt-hours in hydraulic mills.

Power Demand

On the basis of data for the 1954-55 season, average monthly "billing demand" for power in hydraulic mill D, operating at 75 tons of seed per day, was estimated as 389 kilowatts.

As operations in class I A are practically continuous, their power consumption will be practically constant. Therefore, their rate of use is equivalent to the figure for their kilowatt-hours per ton of seed (36 kw.-hr.),

multiplied by the tons of seed processed per hour (3+ tons). Accordingly, demand for class I A operations in hydraulic mill D was 112.5 kilowatts. This figure was rounded to 113.

Meal processing (I B) demand in converted mills was assumed to be unchanged by conversion and therefore it was included with the nonproducing demand.

Subtracting the demand for class I A operations (113 kw.) from the total of 389 kw. gave 276 kilowatts for delinting (II A), meal processing (I B), and miscellaneous operations (II B). For any given mill this total demand minus producing demand remains the same regardless of the oil extraction process, because the equipment and its use are not affected by a change in extraction process. Adding this demand to the producing demand for any converted mill gives the total demand, otherwise known as billing demand.

Fuel

Different types of mills require different amounts of heat for cooking and drying meats, and, in solvent mills, for desolventizing oil and meal (table 9). The amounts vary for any mill with the moisture in the meats or added to them and with the quantity of meats yielded by the seed.

Table 9.--Expected increase in fuel requirements and costs per ton of seed in converting hydraulic cottonseed oil mills into alternative types of mills, 1955-56

Type of mill	Heat requirements in B. t. u.			Increase 3/	
	Theoretical 1/	Actual 2/		Fuel oil (No. 6)	Cost
		Total	Increase		
	Number	Number	Number	Gallons	Cents
Hydraulic	172,000	516,000			
Screw press	250,000	750,000	234,000	1.54	12.3
Direct solvent	576,000	1,728,000	1,212,000	7.97	63.8
Prepress solvent ...	394,000	1,182,000	666,000	4.38	35.0

1/ Amount of fuel needed if none of the thermal energy were wasted.
2/ With 33.3 percent overall efficiency in heat utilization, actual requirements are 3 times the theoretical.
3/ Based on 152,000 B.t.u. per gallon of No. 6 oil and price of 8 cents per gallon. This was approximately the average price of No. 6 oil delivered in tank cars at Memphis, September 1954 through August 1955, as reported by oil producers and distributors.

Column 1 in table 9 presents the theoretical heat requirements for processing seed by different processes. Based on these calculated theoretical heat requirements, data from a recent survey of mills throughout the cottonseed industry showed that the efficiency of utilization of the heat in the fuel was approximately 33.3 percent for all types of mills. The actual requirements for average mills are given in column 2 of table 9.

Savings in fuel costs due to improving the existing heating system during the course of a conversion, should not be credited to conversion because the same improvements and savings in fuel cost could be accomplished without conversion. The extent to which conversion would increase heat requirements is equivalent to the thermal units needed by the converted mill minus those needed by the hydraulic mill (col. 3, table 9), both calculated at 33.3 percent efficiency.

Knowledge of the number of thermal units in a gallon of oil, a cubic foot of gas, or a ton of coal permits a conversion of increased heat requirements into terms of the specific fuel. Multiplying this added fuel requirement by the price per unit of fuel gives the increase in fuel cost. For example, the heat value of No. 6 fuel oil is 152,000 British thermal units per gallon, and the screw-press process requires approximately 234,000 units, or 1.54 gallons of No. 6 fuel oil, per ton of seed more than does the hydraulic process. Therefore, the increase in fuel costs for a screw-press conversion is 15.4 cents per ton if the oil price is 10 cents per gallon, or 12.3 cents per ton if the price is 8 cents.

For comparison purposes, this study used No. 6 fuel oil, and a price of 8 cents per gallon. 5/ Coal was not used because the various types of coal used were not known and, even if they had been known, data on their respective heat contents were not available. Fuel gas was not used because, in contrast to oil or coal, the cost per unit (1,000 cubic feet of fuel gas) varies with the total volume used.

Maintenance and Repair

The extent to which conversions were expected to increase maintenance and repair cost is shown in table 10.

In this report, it has been assumed that converting to any alternative mill would not appreciably alter the size of the maintenance and repair labor force. This assumption does not affect the treatment of the maintenance and repair cost data, however, because, as a general rule, the cost of maintenance and repair labor is accounted for in the overall labor cost of a mill. The maintenance and repair cost, therefore, contains only costs of materials and supplies.

5/ Reported by commercial distributors in tank-car lots at Memphis (average of approximately 8 cents) from September 1954 through August 1955.

Table 10.--Expected increases in maintenance and repair costs per ton of seed in converting hydraulic cottonseed oil mills into alternative types of mills, 1955-56

Type of mill	Maintenance and repair cost on oil extraction equipment 1/	
	Cost	Increase
	Cents	Cents
Hydraulic	2/ 17	
Screw press	2/ 40	23
Direct solvent ...	3/ 40	23
Prepress solvent .	4/ 43	26

1/ Maintenance and repair on other buildings and equipment would be the same after conversion as before.
2/ Based on data from a recent survey of cottonseed oil mills.
3/ Based on assumption that direct-solvent and screw-press mills have same maintenance and repair cost.
4/ Limited data from manufacturers of both direct-solvent and prepress-solvent equipment indicated that maintenance and repair for the latter was approximately 3 cents more per ton of seed.

For any hydraulic mill, the maintenance and repair cost would remain the same after conversion as before, except for the pressroom. Actual pressroom repair expense for some of the hydraulic mills in this study was not available. In a recent survey of the industry, the average pressroom repair and maintenance cost for the small number of hydraulic mills reporting these costs was 17 cents per ton of seed. This figure was used in this study.

Only limited data were available for estimating the expected maintenance and repair costs for the new oil extraction equipment in each of the converted mills. These data were as follows: In a recent survey, 15 low-speed screw-press mills reported an average pressroom maintenance and repair cost of approximately 52 cents per ton. The similar figure for 9 high-speed screw-press mills was about 28 cents per ton. It was assumed that the difference between these figures was mainly accounted for by the fact that the high-capacity

screw-press mills were newer installations as compared with the low-capacity screw-press mills. In line with this assumption, it was concluded that an average of approximately 40 cents per ton of seed for both groups of mills was a reasonable estimate of maintenance and repair cost over the useful life of either type of installation.

In solvent plants, there are certain important maintenance and repair items for which no specific figures are available. These are: (1) the ever-present danger of explosion due to carelessness, (2) the amount of time involved in repairing the extractor (especially for cooling it down and bringing the temperature up again), (3) more rigid controls in all the processing operations to do an efficient extraction job.

As shown in tables 21 through 23 of appendix II, the cost of extraction equipment per ton of seed is appreciably less for screw-press mills than for direct-solvent mills. But the lesser cost is offset by the greater wear on screw-press equipment. For this reason, the same per-ton cost of maintenance and repair was assumed for both types of extraction departments.

Laboratory Services

With one exception, no conversion would necessarily alter the cost of laboratory service. The exception is the conversion to screw presses, in which case analyses of additional samples of cake would be customary as a frequent check on the efficiency of pressing. This study allowed two samples per press per week. On the basis of data from commercial laboratories, $1.55 was allowed for each cake sample, which is equivalent to $3.10 per press per week or 62 cents per day for a 5-day week. This cost of 62 cents was multiplied by the number of presses, and the result divided by the mill's daily crush, giving the additional laboratory cost per ton of seed.

Press Cloth

Cost of press cloth would be eliminated by any type of conversion. This cost averaged 20 cents per ton of seed for the 1954-55 season for the 5 mills studied. This average was nearly the same as that shown by a survey of 29 mills for the 1953-54 season, and therefore was used in this report.

Solvent Loss

Although solvent may be used many times over, some is lost with each use. The rate of loss is lower for the prepress-solvent mills than for direct-solvent mills because of a different structure of flaked meats, arising from the prepress operation. This report used a solvent loss of 3 gallons per ton of seed for direct-solvent mills, and 2 gallons for prepress-solvent mills. A recent survey indicated that these rates may be reasonably expected, although some mills have reported a loss as low as 1 gallon per ton and others have reported a loss of over 4 gallons.

Producers and distributors of hexane solvent reported their average Memphis price as approximately 18.5 cents per gallon delivered in tank-car lots during the period September 1954 through August 1955. This price was used.

Soapstock

Because of its lower fat content, solvent meal is more dusty and difficult to pellet than is hydraulic or screw-press meal. Some feed mixers object to buying a dusty meal because of the blowing and loss in handling. Many animal feeders object to the low fat content of solvent meal as well as to its dusty quality. The addition of some conditioning material is needed to avoid segregation after mixing, to avoid coughing and choking of livestock, and to permit the production of "soft pellets." Molasses or some form of fat most commonly is added. This study has assumed acidulated soapstock to be the additive.

Enough acidulated soapstock usually is added to the meal to bring its fat content up to 2 or 3 percent of the weight of the meal, the percentage varying somewhat among managements. The figure of 2 percent was used here. The estimated amounts added and their cost per ton of seed are shown in table 11.

Table 11.--Estimated cost of acidulated soapstock used by direct-solvent and prepress-solvent cottonseed oil mills, 1955-56

Type of mill	Meal yield per ton of seed 1/	Residual oil in meal		Soapstock to raise fat in meal to 2 percent	Cost of soapstock per ton of seed 2/
		Amount	Percentage		
	Pounds	Pounds	Percent	Pounds	Cents
Direct solvent	982	9.8	1.0	9.8	46.6
Prepress solvent ..	982	4.9	.5	14.7	69.8

1/ Assuming production of 8.0 percent ammonia meal from cottonseed having 4.18 percent ammonia.
2/ Memphis brokers reported average price of 4.75 cents per pound of acidulated soapstock delivered to mills during September 1955 through February 1956.

Water

Mills were not comparable with respect to their water costs, particularly because some of them had their own wells. They were made comparable for this study through the assumption that they all used the same amount of water per ton of seed and purchased it from a municipality. Variations in water requirements and costs of different types of mills are shown in table 12.

Table 12.--Water requirements and costs per ton of seed in converting hydraulic cottonseed oil mills into alternative types of mills, 1955-56

Type of mill	Water requirements 1/	Cost 2/ Amount	Cost 2/ Increase
	Gallons	Cents	Cents
Hydraulic	22	0.55	
Screw press	56	1.40	0.85
Direct solvent	321	8.02	7.47
Prepress solvent	221	5.52	4.97

1/ From table 68, page 127, in USDA Marketing Research Report No. 54, February 1954.

2/ Based on an average cost of 25 cents per 1,000 gallons of water which was estimated from water rates of 20 cottonseed oil mill locations in Arkansas, Georgia, Louisiana, South Carolina, Oklahoma, and Texas.

CHANGE IN TOTAL COST

All changes in current costs expected from each of the conversions under consideration are summarized in table 13.

By combining fixed annual charges on new investment with these changes in current costs, table 14 shows the expected effect of each conversion on total cost per ton of seed for annual crushes representing operating seasons of 3, 6, 9, and 12 months for each mill. The decline of this total cost with increases in length of season and size of crush is due to spreading the fixed annual charges on new investment over more tons of seed. This is true because the same change in current cost per ton must be assumed regardless of the length of season and size of annual crush.

In conversion of a given mill, there may be a decrease in current cost per ton; but for small annual crushes, fixed cost on the new investment is greater per ton than the decrease in current cost, so that conversion results in an increase in total cost per ton. With increase in annual crush, and consequent decrease in new investment cost per ton, some point may be reached where the increase in total cost per ton resulting from conversion changes to a decrease. For each of the 3 smallest mills, figure 1 shows the size of crush at which conversion to screw presses was first expected to show positive savings in total cost.

Table 13.--Expected changes in current operating costs per ton of seed in converting 5 specified hydraulic cottonseed oil mills into alternative types of mills, 1955-56

Mill	Normal daily crushing capacity	Through-put per screw press per 24 hours	Changes in current operating costs: Labor 1/	Electric power 2/	Maintenance and repairs 3/	Fuel 4/	Solvent 5/	Soap-stock 6/	Laboratory expense 7/	Press cloth 8/	Water 9/	Total: Increase	Total: Decrease	Net per ton
	Tons	Tons	Dollars	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Dollars	Dollars	Dollars
Mill A--Hydraulic mill converting to:														
Screw press--														
4 presses	150	37.50	-1.24	52	23	12.3			1.6	-20	0.85	0.90	1.44	-0.54
5 presses	150	30.00	-1.24	58	23	12.3			2.0	-20	.85	.96	1.44	- .48
6 presses	150	25.00	-1.24	60	23	12.3			2.5	-20	.85	.99	1.44	- .45
Direct solvent	150		-1.02	- 9	23	63.8	55.5	46.6		-20	7.47	1.96	1.31	.65
Prepress solvent	150		- .83	18	26	35.0	37.0	69.8		-20	4.97	1.91	1.03	.88
Mill B--Hydraulic mill converting to:														
Screw press--														
3 presses	130	43.33	-1.23	46	23	12.3			1.4	-20	.85	.84	1.43	- .59
4 presses	130	32.50	-1.23	58	23	12.3			1.9	-20	.85	.96	1.43	- .47
5 presses	130	26.00	-1.23	60	23	12.3			2.4	-20	.85	.99	1.43	- .44
Direct solvent	130		- .97	- 9	23	63.8	55.5	46.6		-20	7.47	1.96	1.26	.70
Prepress solvent	130		- .75	18	26	35.0	37.0	69.8		-20	4.97	1.91	.95	.96
Mill C--Hydraulic mill converting to:														
Screw press--														
3 presses	110	36.66	-1.45	53	23	12.3			1.7	-20	.85	.91	1.65	- .74
4 presses	110	27.50	-1.45	59	23	12.3			2.3	-20	.85	.97	1.65	- .68
Direct solvent	110		-1.14	- 9	23	63.8	55.5	46.6		-20	7.47	1.96	1.43	.53
Prepress solvent	110		- .88	18	26	35.0	37.0	69.8		-20	4.97	1.91	1.08	.83
Mill D--Hydraulic mill converting to:														
Screw press--														
2 presses	75	37.50	-1.53	52	23	12.3			1.7	-20	.85	.90	1.73	- .83
3 presses	75	25.00	-1.53	60	23	12.3			2.5	-20	.85	.99	1.73	- .74
Direct solvent	75		-1.08	- 9	23	63.8	55.5	46.6		-20	7.47	1.96	1.37	.59
Prepress solvent	75		- .70	18	26	35.0	37.0	69.8		-20	4.97	1.91	.90	1.01
Mill E--Hydraulic mill converting to:														
Screw press--														
1 press	50	50.00	-2.12	40	23	12.3			1.2	-20	.85	.77	2.32	-1.55
2 presses	50	25.00	-2.12	60	23	12.3			2.5	-20	.85	.99	2.32	-1.33

1/ From table 6. 2/ From table 7. 3/ From table 10. 4/ From table 9. 5/ Based on 3 gallons per ton of seed for direct-solvent mills and 2 gallons for prepress-solvent at 18.5 cents per gallon (average price of hexane delivered in tank carlots at Memphis from September 1954 through August 1955). 6/ From table 11. 7/ Number of presses x $3.10 for 2 cake samples per press per week/5 (daily crushing capacity per mill). 8/ Average of the 5 mills for 1954-55 season. This is approximately the same as average for 29 mills during 1953-54 season. 9/ From table 12.

Table 14.--Expected increases in total cost per ton of seed in converting 5 specified hydraulic cottonseed oil mills into alternative types of mills, by size of annual crush, 1955-56

Hydraulic mill and tons crushed annually 1/	Normal daily crushing capacity	Increases in total cost per ton of seed for conversions to-- 2/							
		Screw-press mills with--						Direct-solvent mill	Prepress-solvent mill
		1 press	2 presses	3 presses	4 presses	5 presses	6 presses		
	Tons	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Mill A:									
39,600	150				0.14	0.28	0.40	2.00	2.08
29,700	150				.36	.54	.69	2.45	2.48
19,800	150				.81	1.05	1.26	3.35	3.28
9,900	150				2.16	2.58	2.96	6.06	5.69
Mill B:									
34,300	130			0.05	.27	.42		2.23	2.45
25,700	130			.26	.52	.71		2.74	2.95
17,200	130			.68	1.01	1.28		3.75	3.93
8,600	130			1.96	2.49	3.01		6.80	6.90
Mill C:									
29,000	110			-.17	.01			1.95	2.34
21,800	110			.02	.24			2.42	2.84
14,500	110			.40	.70			3.37	3.86
7,300	110			1.53	2.06			6.17	6.84
Mill D:									
19,800	75		-0.11	.15				2.62	2.95
14,900	75		.12	.44				3.29	3.59
9,900	75		.60	1.04				4.65	4.89
5,000	75		2.00	2.78				8.62	8.68
Mill E:									
13,200	50	-0.93	- .45						
9,900	50	- .72	- .16						
6,600	50	- .31	.42						
3,300	50	.93	2.18						

1/ Crushes for each mill represent operating seasons of approximately 12, 9, 6, and 3 months, respectively, assuming an average of 22 24-hour working days per month.

2/ Fixed charges per ton in table 4 plus net change in current cost from table 13.

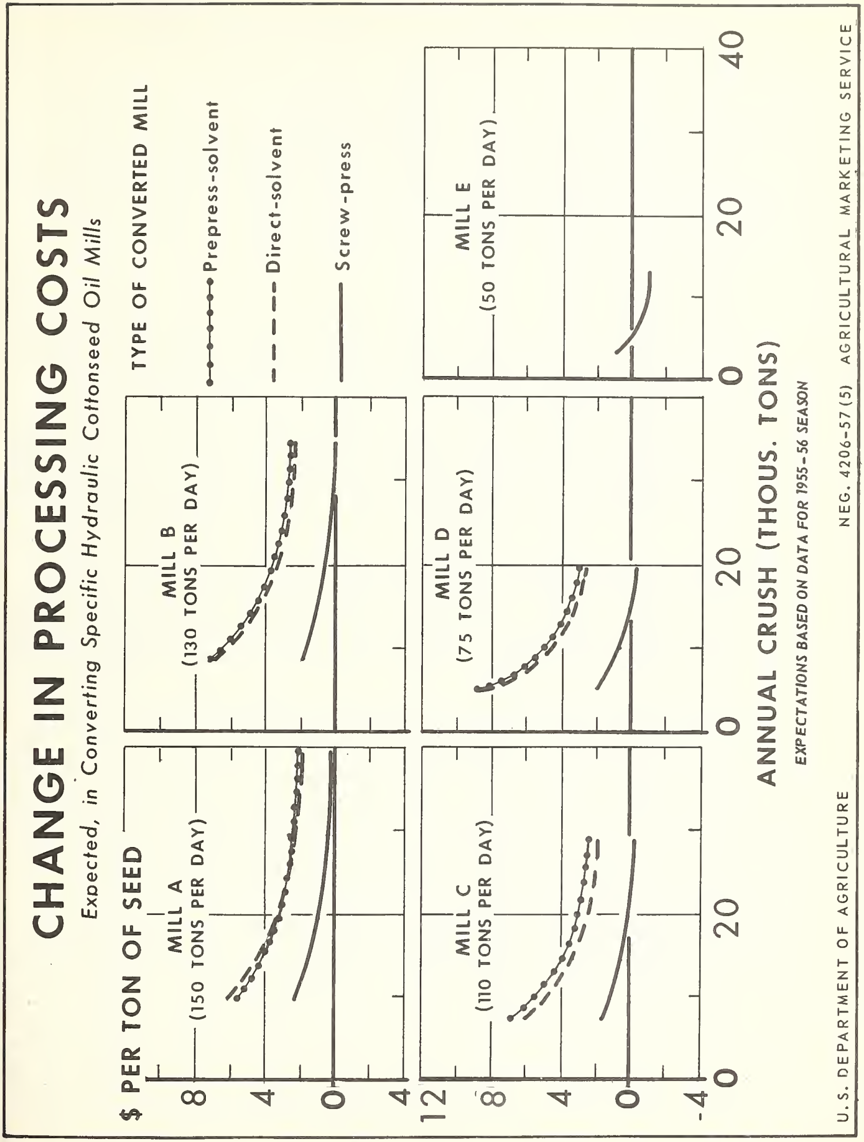
CHANGE IN PROCESSING COSTS
Expected, in Converting Specific Hydraulic Cottonseed Oil Mills
$ PER TON OF SEED
MILL A
(150 TONS PER DAY)
MILL B
(130 TONS PER DAY)
MILL C
(110 TONS PER DAY)
MILL D
(75 TONS PER DAY)
MILL E
(50 TONS PER DAY)
TYPE OF CONVERTED MILL
Prepress-solvent
Direct-solvent
Screw-press
8
4
0
4
12
8
4
0
-4
0
20
0
20
0
20
40
ANNUAL CRUSH (THOUS. TONS)
EXPECTATIONS BASED ON DATA FOR 1955-56 SEASON
U.S. DEPARTMENT OF AGRICULTURE
NEG. 4206-57 (5)
AGRICULTURAL MARKETING SERVICE

Figure 1

EFFECT OF CONVERSIONS ON GROSS REVENUE PER TON OF SEED

In estimating the effect of conversions on gross revenue per ton of seed, changes only in meal and oil revenue need be calculated. It was assumed that the additional oil extracted from the meats by the screw-press and solvent processes would be replaced by an equivalent weight of hulls so as to produce 41 percent protein meal, which is the usual percentage. This would reduce present hull yields somewhat but not enough to make any appreciable difference in hull revenue. Linter yields and revenue would remain the same. While meal yield would remain the same, meal revenue might be different owing to price differentials between meals produced by different types of mills.

Oil

Three factors entered into the calculation of the effect of conversion on oil revenue: Oil yield, quality, and price. The expected effect of yield was calculated on the assumption that the oil actually produced and sold would be equivalent to the total oil in the seed minus the oil left in the meal by a given process and an estimated additional 4 pounds left in the hulls and linters. Although this assumption will not be strictly accurate in all cases, it is based on the best data available, and is a common assumption in the industry. The seed processed by the 5 hydraulic mills averaged 4.18 percent ammonia for the 1953-54 and 1954-55 seasons, consequently yielding 982 pounds of 41-percent protein meal.

Based on chemical analyses of meal or cake samples over a 2-year period, the 5 hydraulic mills averaged 5 percent residual oil in the meal. It is commonly recognized that direct- and prepress-solvent mills can achieve a residual oil of 1.0 and 0.5 percent, respectively; or 9.82 pounds and 4.91 pounds for the 982 pounds of meal in a ton of seed. The residual oil, for different rates of throughput for screw presses, is shown in table 15 and by line B in figure 11 of appendix I.

The expected gain in oil yield from each conversion was then obtained by subtracting the oil left in the meal by the converted mills from the oil left in the meal by the hydraulic process (table 15).

There is considerable discussion in the industry of the question whether any specific differences in refining loss and oil color are attributable to differences in oil extraction equipment. It was recognized that this subject needs investigation under carefully controlled conditions, but nevertheless it was assumed in this study that all types of mills would produce the same quality of oil. Based on the reports of their normal oil quality, the 5 hydraulic mills averaged 6.4 percent refining loss and a color red of 5.5. These figures were used in calculating the value of the oil gains from different conversions.

Table 15.--Expected change in oil and meal revenue per ton of seed in converting 5 specified hydraulic cottonseed oil mills into alternative types of mills, 1955-56

Mill	Throughput per screw press per day 1/	Residual oil in meal 2/		Oil gain		Decrease in meal revenue 4/	Net gain in gross revenue 5/
		Percentage	Amount	Quantity	Value 3/		
	Tons	Percent	Pounds	Pounds	Dollars	Dollars	Dollars
Mill A (150 tons per day):							
Present hydraulic		4.8	47				
Screw press--							
4 presses	37.50	2.9	28	19	2.50		2.50
5 presses	30.00	2.6	26	21	2.89		2.89
6 presses	25.00	2.4	23	24	3.16		3.16
Direct solvent 4/		1.0	10	37	4.95	1.47	3.48
Direct solvent 6/		1.0	10	37	4.95	0	4.95
Prepress solvent 4/		.5	5	42	5.62	1.47	4.15
Prepress solvent 6/		.5	5	42	5.62	0	5.62
Mill B (130 tons per day):							
Present hydraulic		4.8	47				
Screw press--							
3 presses	43.33	3.1	31	16	2.20		2.20
4 presses	32.50	2.7	27	20	2.75		2.75
5 presses	26.00	2.4	24	23	3.10		3.10
Direct solvent 4/		1.0	10	37	4.95	1.47	3.48
Direct solvent 6/		1.0	10	37	4.95	0	4.95
Prepress solvent 4/		.5	5	42	5.62	1.47	4.15
Prepress solvent 6/		.5	5	42	5.62	0	5.62
Mill C (110 tons per day):							
Present hydraulic		4.8	47				
Screw press--							
3 presses	36.67	2.9	28	19	2.54		2.54
4 presses	27.50	2.5	25	22	3.02		3.02
Direct solvent 4/		1.0	10	37	4.95	1.47	3.48
Direct solvent 6/		1.0	10	37	4.95	0	4.95
Prepress solvent 4/		.5	5	42	5.62	1.47	4.15
Prepress solvent 6/		.5	5	42	5.62	0	5.62
Mill D (75 tons per day):							
Present hydraulic		4.8	47				
Screw press--							
2 presses	37.50	2.9	28	19	2.50		2.50
3 presses	25.00	2.4	23	24	3.16		3.16
Direct solvent 4/		1.0	10	37	4.95	1.47	3.48
Direct solvent 6/		1.0	10	37	4.95	0	4.95
Prepress solvent 4/		.5	5	42	5.62	1.47	4.15
Prepress solvent 6/		.5	5	42	5.62	0	5.62
Mill E (50 tons per day):							
Present hydraulic		4.8	47				
Screw press--							
1 press	50.00	3.4	33	14	1.85		1.85
2 presses	25.00	2.4	23	24	3.16		3.16

1/ Tons per day divided by number of presses. 2/ Percentages from fig. 11 for different screw-press throughputs. Percentages for hydraulic mills were based on chemical analysis of cake produced over a 2-year period. Amounts based on 982 pounds of meal per ton of seed. 3/ Based on 1952-55 average of 13.13 cents per pound of prime crude oil, Memphis, plus premium of $\frac{3}{4}$ of 1 percent of the contract price for each 1 percent that refining loss is below 9 percent. Normal refining loss for the 5 specified hydraulic mills was 6.4 percent; the values of the oil gains were calculated at 13.39 cents per pound. From available data, no relationship can be established between oil quality and type of mill. 4/ Solvent meal selling at $3 per ton under screw-press meal and meal yield of 982 pounds per ton of seed. 5/ Based on unrounded oil gains. 6/ Solvent meal and screw-press meal selling at same price.

Upon the close of the Korean conflict, the price of oil dropped a third, but since then it has remained relatively stable. The average price received for prime crude oil by Mississippi Valley mills during the 1952-55 period was 13.13 cents per pound. Trading rules of the National Cottonseed Products Association specify that three-fourths of 1 percent of the contract price will be paid for each 1 percent that refining loss is below 9 percent. If oil has a color red below 7.6, it receives no penalty, but there is no premium.

Adjusting the price of 13.13 cents for prime oil to oil with a 6.4 percent refining loss and 5.5 color red gives a price of 13.39 cents per pound. This figure was used in calculating how much the increases in oil yields from the different mill conversions (table 15) were expected to increase oil revenue per ton of seed. These gains would vary upward or downward with the price of oil.

Meal

The gains in oil output of mills converted to types having higher oil yields might be counteracted appreciably by lower prices for their meal. On the basis of interviews with feed dealers, oil mill operators, and brokers in the Valley and western Cotton Belt, table 16 shows a wide variation of price differentials between meals produced by different types of cottonseed oil mills.

There is no fixed differential between any meals. In some instances, solvent mills received as much for their meal as did screw-press or hydraulic mills; and, at the other extreme, some screw-press or hydraulic mills sold for $5 more per ton than solvent, the usual premium being approximately $3. As previously discussed, feed mixers do not always care greatly whether they buy meal with a satisfactory fat content or add soapstock themselves. They may pay the same for both meals. But when animal feeders are the principal buyers, solvent meal may fall even more than $5 per ton below mechanically-produced meals.

Usually the hydraulic and screw-press meals sell at the same price, and slab-cake sells for $1 to $3 less per ton than ground hydraulic meal, averaging about $2 less. As an exception, during the 1955-56 season some producers of slab-cake have obtained $1 per ton more than for hydraulic meal, or $4 more than for solvent bulk meal, due primarily to the strong foreign demand for slab-cake.

The importance of meal price differentials in mill conversion was analyzed under two meal market situations. The first was the usual situation in which hydraulic and screw-press meals sell at the same price and both bring $3 more per ton than solvent meal. In this situation, converting a hydraulic mill to either type of solvent mill would reduce meal revenue by $1.47 per ton of seed, still assuming 982 pounds of meal per ton of seed. The second situation is the less common one in which all meals bring the same price.

Findings in this report can be adjusted to any meal price differential that may prevail in a particular market. If, for example, one can expect $1 more per ton for hydraulic meal than for screw-press meal, a screw-press

Table 16.--Price differentials among meals produced by different types of cottonseed oil mills, 1955-56 1/

A. Normal relationship

Type of premium	Amount of premium per ton of meal: Range	Average
	Dollars	Dollars
Mechanically processed meal over solvent meal 2/	1.00-5.00	3.00
Mechanically processed meal (bulk) over slab-cake	1.00-3.00	2.00
Slab-cake over solvent bulk meal	0.00-2.00	1.00

B. Exceptional relationship

Type of premium	Range	Average
Slab-cake over mechanically processed meal (bulk)	0.00-2.00	1.00
Slab-cake over solvent bulk meal	3.00-5.00	4.00
Mechanically processed meal over solvent meal 2/	0	0
Hydraulic meal over screw-press meal 2/	0.00-4.00	2.00

1/ Based on interviews with mixed-feed dealers, mill operators, and meal brokers in Valley and Western cotton regions.
2/ Irrespective of way in which the meals are "packaged"--bulk, sacked, pelleted, cracked, or sized cake.

conversion would reduce gross meal revenue, and hence total mill revenue, by approximately 50 cents per ton of seed. In many cases, change in the gross revenue of a mill will represent two offsetting items--increase in oil value and decrease in meal value. In many other cases, however, the change will consist solely of the value of increased oil yield.

EFFECT OF CONVERSIONS ON NET REVENUE

By consolidating the changes in total cost and total revenue, table 17 shows the expected change in net revenue per ton of seed and the amount of new revenue, expressed as a rate per dollar of new investment, for conversions of each of the 5 specified hydraulic mills with annual crushes representing operating seasons of approximately 3, 6, 9, and 12 months.

Most Profitable Number of Screw Presses for Mills of Given Daily Capacities

A given hydraulic mill may be converted into a screw-press mill with any one of two or more different numbers of presses, depending on the daily mill capacity and the practical range of throughputs per screw press. For example, a 50-ton-per-day hydraulic mill may be converted to either a 1-press or a 2-press screw-press mill.

Screw-press conversions discussed in this report involve 9 different throughputs per screw press. With minor exceptions, these range from 30.0 to 43.3 tons per day. Extreme throughputs of 25 and 50 tons were used for mill E because its daily capacity of 50 tons did not permit any intermediate throughputs. The 25-ton throughput was used also for mill D, along with a 37.5-ton througnput, in order to compare the net return advantages of converting 75-ton-per-day hydraulic mills into screw-press mills with either 2 or 3 presses. It was again used to compare the advantages of converting mill A (150-ton-per-day) into a screw-press mill with 4, 5, or 6 screw presses.

Screw-press conversions with the largest number of presses physically compatible with a given daily mill capacity generally yield more additional net revenue per ton of seed than do conversions with the smallest number of presses. However, the reverse is true for the increase in revenue expressed as a rate of return per dollar of new investment. Conversion to a larger number of presses permits a lower throughput per press, and thereby gives a higher oil yield. The increase in oil yield and revenue for the larger number of presses exceeds the increase for fewer presses enough to show a greater increase in net revenue per ton of seed than does the smaller number. Gain stated as return per dollar of new investment was less, however, than that for conversion to the smaller number of presses. This was true because increase in investment for the larger number of presses was proportionally greater than the increase in net revenue per ton of seed. As an example, for mill C, crushing 29,000 tons of seed per year, the increased return from conversion was 11

Table 17.--Expected change in net revenue expressed as return per ton of seed and per dollar of investment in converting 5 specified hydraulic cottonseed oil mills into alternative types of mills, by size of annual crush, 1955-56

Mill and tons crushed annually	Hydraulic mill converting to: 1/																			
	Screw-press mills with: 2/												Direct solvent mill				Prepress-solvent mill			
	1 press		2 presses		3 presses		4 presses		5 presses		6 presses		With $3 discount per ton of meal		With no meal discount		With $3 discount per ton of meal		With no meal discount	
	Per ton of seed	Per dollar of new investment	Per ton of seed	Per dollar of new investment	Per ton of seed	Per dollar of new investment	Per ton of seed	Per dollar of new investment	Per ton of seed	Per dollar of new investment	Per ton of seed	Per dollar of new investment	Per ton of seed	Per dollar of new investment	Per ton of seed	Per dollar of new investment	Per ton of seed	Per dollar of new investment	Per ton of seed	Per dollar of new investment
	Dol.	Ct.	Dol.	Ct.	Dol.	Ct.	Dol.	Ct.	Dol.	Ct.	Dol.	Ct.	Dol.	Ct.	Dol.	Ct.	Dol.	Ct.	Dol.	Ct.
Mill A - 150 tons per day:																				
39,600	3/xx	xx	xx	xx	xx	xx	2.36	33.6	2.61	33.1	2.76	31.7	1.48	11.0	2.95	22.0	2.07	17.3	3.54	29.6
29,700	xx	xx	xx	xx	xx	xx	2.14	22.8	2.35	22.4	2.47	21.3	1.03	5.7	2.50	14.0	1.67	10.5	3.14	19.7
19,800	xx	xx	xx	xx	xx	xx	1.69	12.0	1.84	11.7	1.90	10.9	.13	.5	1.60	6.0	.87	3.6	2.34	9.8
9,900	xx	xx	xx	xx	xx	xx	.34	1.2	.31	1.0	.20	.6	-2.58	-4.8	-1.11	-2.1	-1.54	-3.2	-.07	-.1
Mill B - 130 tons per day:																				
34,300	xx	xx	xx	xx	2.15	33.2	2.48	33.2	2.68	31.0	xx	xx	1.25	8.4	2.72	18.3	1.70	11.8	3.17	22.0
25,700	xx	xx	xx	xx	1.94	22.4	2.23	22.4	2.39	20.7	xx	xx	.74	3.7	2.21	11.1	1.20	6.2	2.67	13.9
17,200	xx	xx	xx	xx	1.51	11.7	1.74	11.6	1.81	10.5	xx	xx	-.27	-.9	1.20	4.0	.22	.8	1.69	5.9
8,600	xx	xx	xx	xx	.24	.9	.26	.8	.08	.2	xx	xx	-3.32	-5.6	-1.85	-3.1	-2.75	-4.8	-1.28	-2.2
Mill C - 110 tons per day:																				
29,000	xx	xx	xx	xx	2.71	45.3	3.01	42.6	xx	xx	xx	xx	1.53	10.9	3.00	21.3	1.81	12.2	3.28	22.1
21,800	xx	xx	xx	xx	2.52	31.6	2.78	29.5	xx	xx	xx	xx	1.06	5.7	2.53	13.5	1.31	6.6	2.78	14.1
14,500	xx	xx	xx	xx	2.14	17.9	2.32	16.4	xx	xx	xx	xx	.11	.4	1.58	5.6	.29	1.0	1.76	5.9
7,300	xx	xx	xx	xx	1.00	4.2	.95	3.4	xx	xx	xx	xx	-2.69	-4.8	-1.22	-2.2	-2.69	-4.6	-1.22	-2.1
Mill D - 75 tons per day:																				
19,800	xx	xx	2.61	35.2	3.01	33.3	xx	xx	xx	xx	xx	xx	.86	4.3	2.33	11.8	1.20	6.4	2.67	14.2
14,900	xx	xx	2.38	24.0	2.72	22.5	xx	xx	xx	xx	xx	xx	.19	.7	1.66	6.3	.56	2.2	2.03	8.2
9,900	xx	xx	1.90	12.8	2.12	11.7	xx	xx	xx	xx	xx	xx	-1.17	-3.0	.30	.8	-.74	-2.0	.73	1.9
5,000	xx	xx	.47	1.6	.35	1.0	xx	xx	xx	xx	xx	xx	-5.14	-6.6	-3.67	-4.7	-4.53	-6.1	-3.06	-4.1
Mill E - 50 tons per day:																				
13,200	2.78	45.5	3.61	42.4	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
9,900	2.57	31.6	3.32	29.2	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
6,600	2.16	17.7	2.74	16.1	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
3,300	.92	3.8	.98	2.9	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx

1/ Gain in gross revenue per ton of seed (table 15) minus changes in total cost per ton of seed (table 14).

2/ Throughput per press per 24 hours = $\frac{\text{daily crushing capacity}}{\text{number of presses}}$

3/ xx indicates no mills in this category.

percent greater with 4 presses than with 3; but new investment being 18 percent greater with 4 presses, each dollar of it actually earned less than with 3 presses.

Prepress-Solvent Conversions More Profitable Than Direct-Solvent Conversions

Prepress-solvent conversions always showed greater return, or less loss, than direct-solvent, both per ton of seed and per dollar of new investment. There were some cases where the crush was too small for either type of solvent conversion to show any increase in the mill's net return. The reasons for the better showing made by the prepress-solvent process were (1) a 5-pound higher oil yield per ton and (2) usually a lower new investment. The current costs for increased labor, power, and soapstock were somewhat higher, but not enough to equal the value of 5 pounds of oil. Only for mill C (110 tons per day) did the new investment for a prepress-solvent conversion exceed that of the direct-solvent, but even in this instance the prepress-solvent returned a greater net revenue per ton of seed and per dollar of new investment than did the direct-solvent (table 17).

Screw-Press Conversion More Profitable Than Prepress-Solvent Conversion Per Dollar of New Investment But Not Always Per Ton of Seed

As compared with conversion to prepress-solvent mills, conversion to screw-press mills showed greater gains in net revenue, stated as returns per dollar of new investment. With usual meal price differentials, screw-press mills also showed greater gains per ton of seed. When compared to solvents with no meal discount, however, the gain in net revenue per ton of seed was sometimes appreciably greater for the prepress-solvent conversion because of its substantially higher oil yield. The reason that the gain stated per dollar of new investment was less for the prepress-solvent was that the investment was much greater than that of the screw-press conversion. An example is the comparison most favorable to the prepress-solvent process, which is the conversion of the 150-ton-per-day hydraulic mill with an expected annual crush of 39,600 tons of seed, representing a 12-month season, and assuming no discount on solvent meal. In this instance, the expected gain in net revenue per ton of seed for the prepress-solvent was 50 percent more than that of the 4-press screw-press conversion, but its investment requirement was 70 percent greater than the screw-press investment. Consequently, its net return, stated as return per dollar of new investment, was 12 percent less than that of the screw-press conversion.

Annual Crushes Required to Justify Conversion

Obviously, any specific crush is too small to justify conversion unless the added income will meet all added costs, fixed as well as current. Beyond this point, the required crushes have been calculated for a range of net

return rates of 5 to 20 cents per dollar on the new investment involved in conversion. The precise rate required in any individual case depends on the alternative investment opportunities which may be available to the investor.

The required sizes of crush have been estimated for (a) conversion of the 5 specified hydraulic cottonseed oil mills and (b) similar conversion of <u>any</u> hydraulic cottonseed oil mill between 50 and 150 tons per day in size.

Sizes of Crush to Yield Given Rates of Return on New Investment in Conversion of 5 Specified Hydraulic Cottonseed Oil Mills

In analyzing the question of profitable sizes of crush for the 5 specified mills for screw-press conversion, only the most profitable number of presses was assumed for each. As previously explained, this means the smallest number of presses physically practical for each mill, as follows:

Normal daily crushing capacity (tons)	Number of screw presses
150	4
130	3
110	3
75	2
50	1

Figure 2 shows return (or loss) per dollar of new investment for each of these conversions as well as conversions to the solvent processes, with variation in length of operating season from 3 to 12 months and with corresponding variation in annual crush.

One can reverse this comparison derived from figure 2, and identify the length of season and size of crush that will enable any type of conversion of each of the 5 mills to yield a given return per dollar of new investment. For example, an annual crush of 19,800 tons, representing a 12-month season for mill D (75 tons per day), was expected to yield 12 percent return on the new investment required for converting into a direct-solvent mill, as compared to 35 percent return for the screw-press. This was true when solvent meal brought the same price as other meals.

The length of season and estimated annual crushes required for conversion to yield 5, 10, 15, and 20 percent rates of return on new investment in converting the 5 hydraulic mills are shown in table 18.

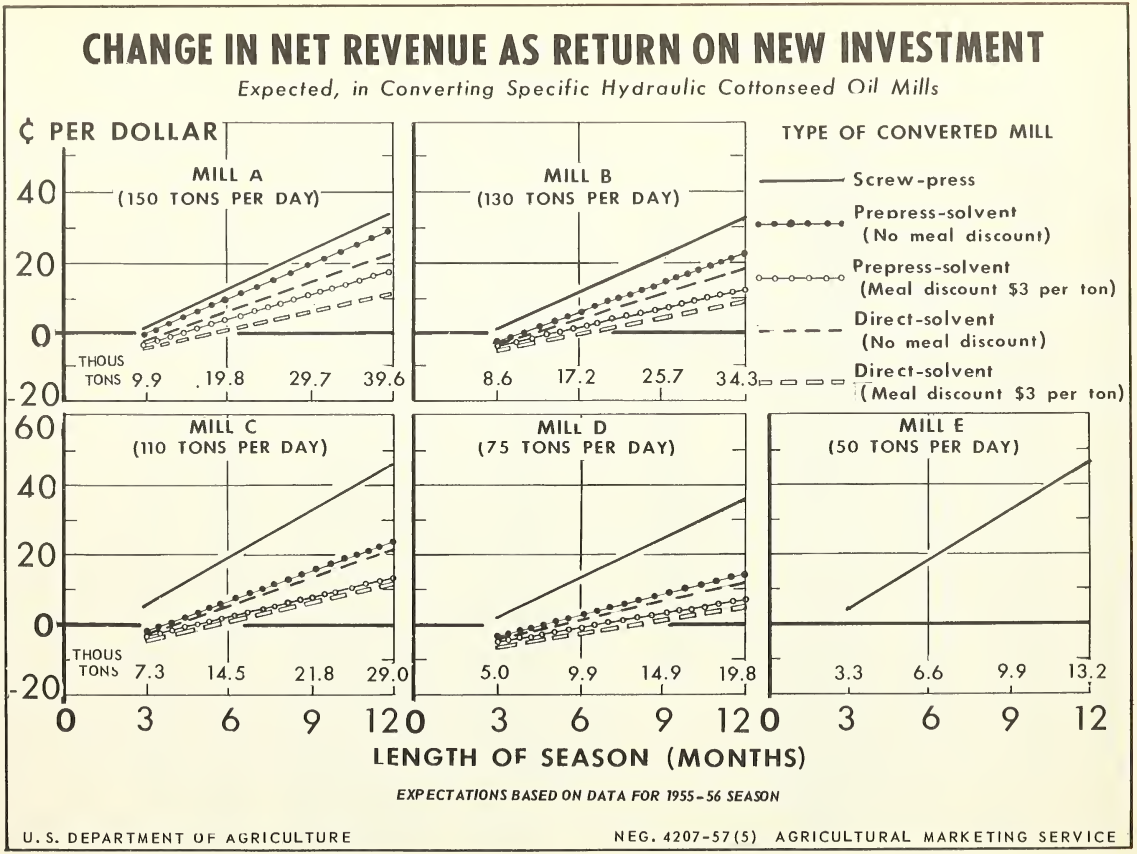
CHANGE IN NET REVENUE AS RETURN ON NEW INVESTMENT
Expected, in Converting Specific Hydraulic Cottonseed Oil Mills
¢ PER DOLLAR
MILL A
(150 TONS PER DAY)
MILL B
(130 TONS PER DAY)
MILL C
(110 TONS PER DAY)
MILL D
(75 TONS PER DAY)
MILL E
(50 TONS PER DAY)
TYPE OF CONVERTED MILL
Screw-press
Prepress-solvent (No meal discount)
Prepress-solvent (Meal discount $3 per ton)
Direct-solvent (No meal discount)
Direct-solvent (Meal discount $3 per ton)
THOUS TONS 9.9 19.8 29.7 39.6
8.6 17.2 25.7 34.3
THOUS TONS 7.3 14.5 21.8 29.0
5.0 9.9 14.9 19.8
3.3 6.6 9.9 13.2
40
20
0
-20
60
40
20
0
-20
0 3 6 9 12
LENGTH OF SEASON (MONTHS)
EXPECTATIONS BASED ON DATA FOR 1955-56 SEASON
U.S. DEPARTMENT OF AGRICULTURE
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Figure 2

Table 18.--Annual crushes and lengths of operating seasons required for conversions to yield specified rates of return per dollar of new investment in converting 5 specified hydraulic cottonseed oil mills into alternative types of mills, 1955-56

Type of conversion, rate of return, and tons normally crushed per day	Screw presses	New investment	Size of annual crush	Length of operating season
	Number	Dollars	Tons	Months
Screw press:				
5 percent				
150	4	278,370	13,400	4.1
130	3	222,620	11,900	4.2
110	3	173,630	8,200	3.4
75	2	146,880	6,500	3.9
50	1	80,590	3,600	3.3
10 percent				
150	4	278,370	18,000	5.5
130	3	222,620	15,800	5.5
110	3	173,630	11,000	4.5
75	2	146,880	8,700	5.3
50	1	80,590	4,800	4.4
15 percent				
150	4	278,370	22,500	6.8
130	3	222,620	19,800	6.9
110	3	173,630	13,700	5.7
75	2	146,880	10,900	6.6
50	1	80,590	6,000	5.5
20 percent				
150	4	278,370	27,000	8.2
130	3	222,620	23,800	8.3
110	3	173,630	16,500	6.8
75	2	146,880	13,100	7.9
50	1	80,590	7,100	6.5
Direct solvent (with no meal discount):				
5 percent				
150		532,070	18,500	5.6
130		509,740	18,200	6.4
110		407,990	14,000	5.8
75		392,120	13,700	8.3
10 percent				
150		532,070	24,500	7.4
130		509,740	24,500	8.6
110		407,990	18,500	7.6
75		392,120	18,200	11.0
15 percent				
150		532,070	30,900	9.4
130		509,740	30,000	10.5
110		407,990	23,000	9.5
20 percent				
150		532,070	37,000	11.2
110		407,990	27,700	11.4
Prepress solvent (with no meal discount):				
5 percent				
150		473,250	15,000	4.5
130		495,100	16,500	5.8
110		431,160	13,000	5.4
75		371,070	12,500	7.6
10 percent				
150		473,250	20,000	6.1
130		495,100	21,500	7.5
110		431,160	18,000	7.4
75		371,070	16,000	9.7
15 percent				
150		473,250	25,000	7.6
130		495,100	26,700	9.3
110		431,160	22,500	9.3
20 percent				
150		473,250	30,000	9.1
130		495,100	32,000	11.2
110		431,160	26,800	11.1

Sizes of Crushes to Yield Given Rates of Return on New Investment in Conversion of Any Hydraulic Cottonseed Oil Mill Between 50 and 150 Tons Per Day

The crushes thus far identified with conversions yielding specified rates of return on new investment are influenced by peculiarities of the 5 specified mills. If these peculiarities were eliminated, more widely applicable results would be obtained for any hydraulic mill between 50 and 150 tons per day. This adaptation was made through the following steps:

First, using the information on new investments in table 1, estimates were made of the relationship between size of mill and new investments required to convert any hydraulic mill between 50 and 150 tons of daily capacity into each alternative type of mill. These relationships are shown as lines in figure 3.

Second, using information in table 4, estimates were made for each type of mill to represent the relationship between size of mill and total annual fixed charges on new investments for conversions of mills of 50 to 150 tons per day in size. These relationships are shown in figure 4.

Third, using data on current costs in table 13, the average relationship between size of mill and current cost per ton of seed for each type of converted mill was estimated for mills from 50 to 150 tons per day in size (figure 5).

In converting any given mill, change in current cost per ton of seed is the same for any size of annual crush, though change in total cost per ton of seed is not the same.

Figures 4 and 5 enable computation of the expected changes in total costs per ton of seed in converting hydraulic mills of sizes from 50 to 150 tons per day. For example, suppose a 120-ton hydraulic mill was being converted into a 3-press screw-press mill with an annual crush of 10,000 tons of seed. The expected annual fixed charges on new investment are approximately $20,475, or $2.05 per ton of seed; the decrease in current cost per ton of seed is 69 cents; and the increase in total cost is $1.36 per ton of seed. Parallel computation can be made for annual crush for any season length ranging from 3 to 12 months.

Fourth, table 19 shows the expected increase in oil revenue per ton of seed in converting hydraulic mills between 50 and 150 tons daily capacity into screw-press mills with the most profitable number of presses for each size of mill.

In converting to either type of solvent mill, the gains in oil yield and oil revenue per ton of seed for each type of mill are constant. As already observed, these gains were calculated for direct-solvent to be 37 pounds in yield and $4.95 in revenue. For prepress-solvent, the corresponding gains were 42 pounds and $5.62.

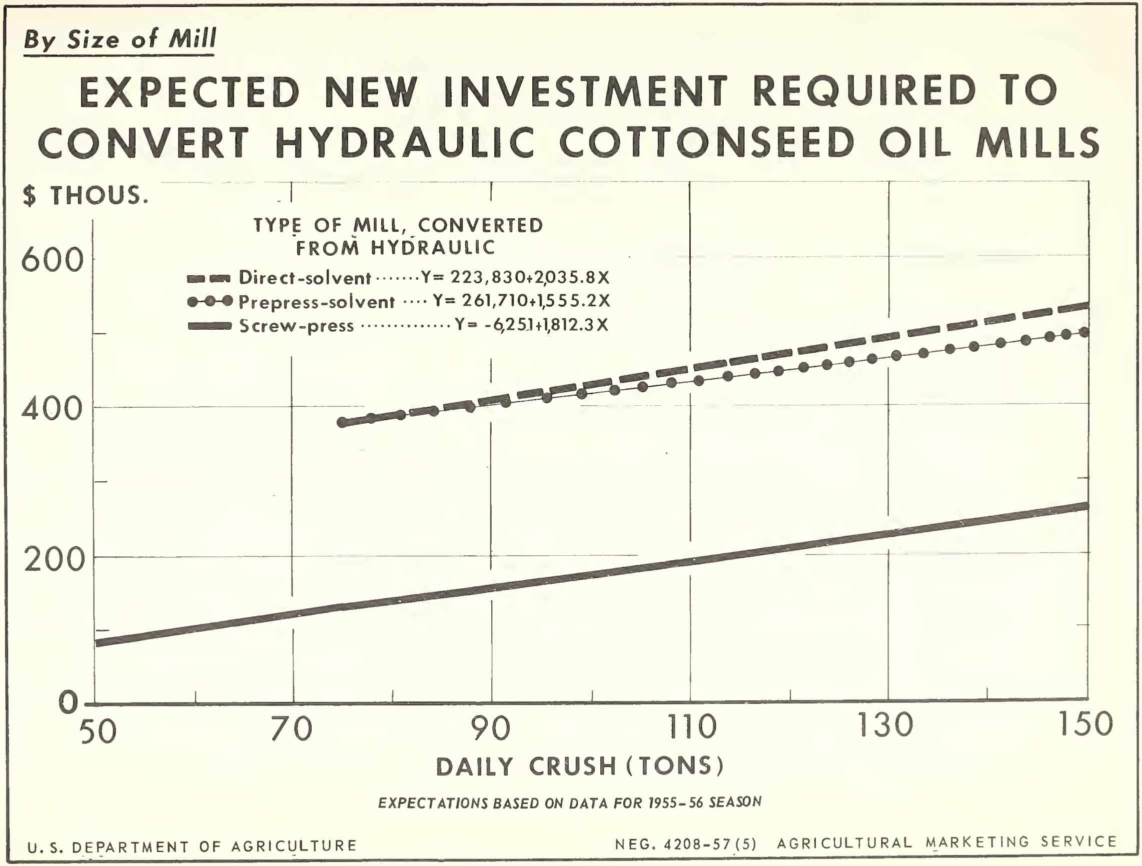
By Size of Mill
EXPECTED NEW INVESTMENT REQUIRED TO CONVERT HYDRAULIC COTTONSEED OIL MILLS
$ THOUS.
TYPE OF MILL, CONVERTED FROM HYDRAULIC
Direct-solvent .... Y= 223,830+2,035.8X
Prepress-solvent .... Y= 261,710+1,555.2X
Screw-press .... Y= -6,251+1,812.3X
600
400
200
0
50
70
90
110
130
150
DAILY CRUSH (TONS)
EXPECTATIONS BASED ON DATA FOR 1955-56 SEASON
U. S. DEPARTMENT OF AGRICULTURE
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Figure 3

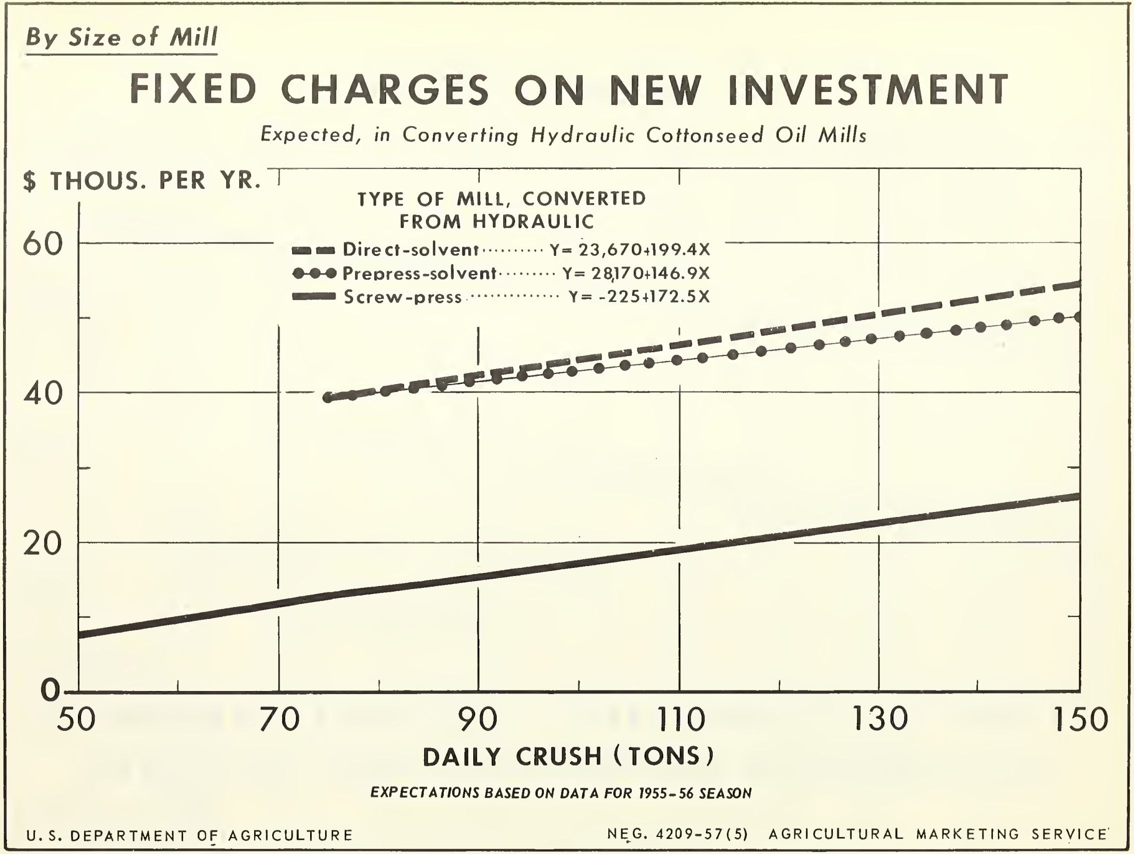
By Size of Mill
FIXED CHARGES ON NEW INVESTMENT
Expected, in Converting Hydraulic Cottonseed Oil Mills
$ THOUS. PER YR.
TYPE OF MILL, CONVERTED FROM HYDRAULIC
Direct-solvent .... Y= 23,670+199.4X
Prepress-solvent .... Y= 28,170+146.9X
Screw-press .... Y= -225+172.5X
60
40
20
0
50
70
90
110
130
150
DAILY CRUSH (TONS)
EXPECTATIONS BASED ON DATA FOR 1955-56 SEASON
U. S. DEPARTMENT OF AGRICULTURE
NEG. 4209-57(5) AGRICULTURAL MARKETING SERVICE

Figure 4

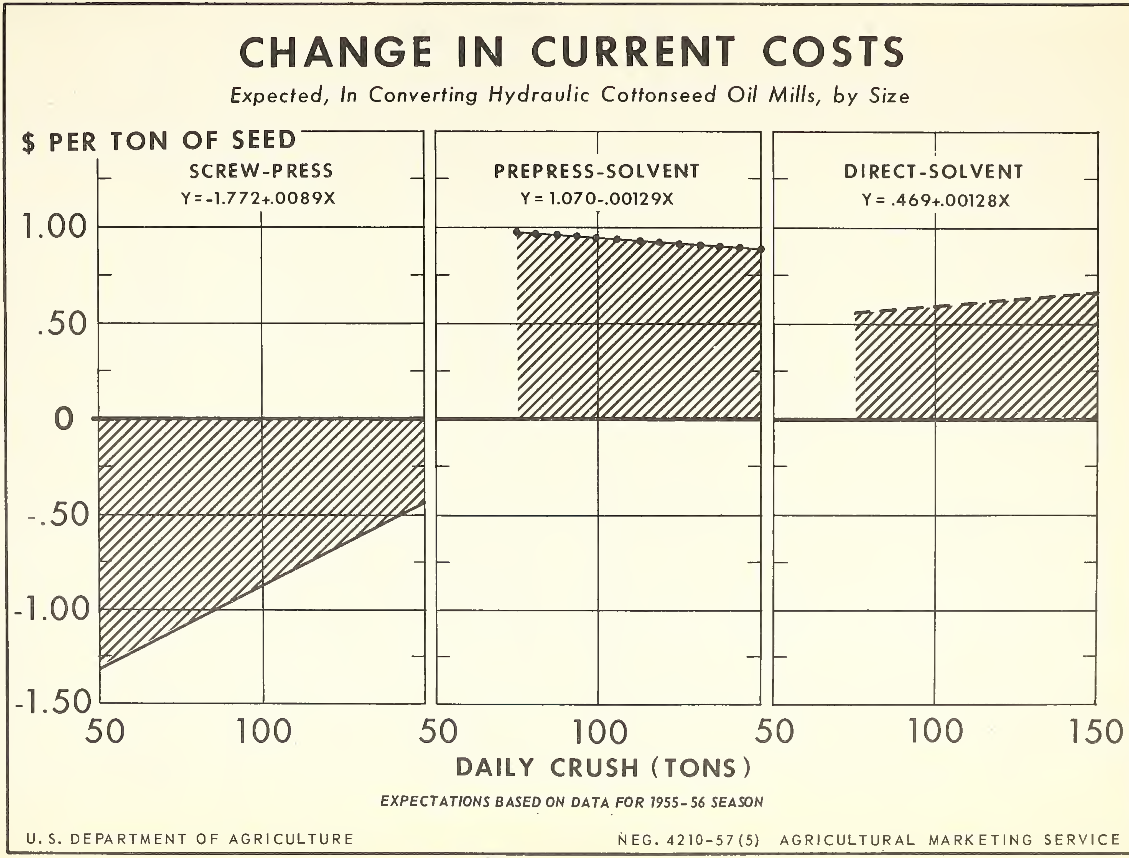
CHANGE IN CURRENT COSTS
Expected, In Converting Hydraulic Cottonseed Oil Mills, by Size
$ PER TON OF SEED
SCREW-PRESS
Y=-1.772+.0089X
PREPRESS-SOLVENT
Y=1.070-.00129X
DIRECT-SOLVENT
Y=.469+.00128X
1.00
.50
0
-.50
-1.00
-1.50
50
100
50
100
50
100
150
DAILY CRUSH (TONS)
EXPECTATIONS BASED ON DATA FOR 1955-56 SEASON
U.S. DEPARTMENT OF AGRICULTURE
NEG. 4210-57(5) AGRICULTURAL MARKETING SERVICE

Figure 5

Table 19.--Expected gain in oil revenue per ton of seed in converting different sizes of hydraulic cottonseed oil mills into screw-press mills, 1955-56

Size of mill (tons normally crushed per day)	Screw presses 1/	Throughput per screw press per day	Oil gain	
			Quantity 2/	Value 3/
	Number	Tons	Pounds	Dollars
150	4	37.50	19	2.50
140	4	35.00	20	2.63
130	3	43.33	16	2.20
120	3	40.00	18	2.37
110	3	36.67	19	2.54
100	3	33.33	20	2.74
90	2	45.00	16	2.11
80	2	40.00	18	2.37
70	2	35.00	20	2.63
60	2	30.00	21	2.89
50	1	50.00	14	1.85

1/ Based on table 17.
2/ Calculated from residual oil in figure 9, and assuming an average hydraulic press rate of 10 tons of seed per press per 24 hours.
3/ Based on unrounded oil gains.

Fifth, through use of these data on gains in oil revenue and the data on changes in fixed and current costs, charts were developed to show the relationships between size of annual crush and expected changes in net revenue stated as revenue--or loss--per dollar of new investment requirements, in converting any hydraulic mill between 50 and 150 tons per day in size into each alternative type of mill. From the lines in these charts, there were read and recorded in table 20 the sizes of crushes needed for conversion to yield given rates of return on new investment.

The crushes specified for each type of solvent conversion were calculated on the assumption that meals produced by all types of mills would bring the same price. Any of the crushes shown can be adjusted upward to allow for any given discount for solvent meal.

From analysis of data for the 5 specific hydraulic mills, several general principles can be derived that apply to the conversion of any hydraulic mill of a daily capacity from 50 to 150 tons.

One generalization that applies with close similarity to the different types of conversion and different sizes of mills deals with the relationship of annual crush and rate of return on the new investment in conversion.

Table 20.--Annual crush required for conversion to yield specified rates of return per dollar of new investment in converting hydraulic cottonseed oil mills into alternative types of mills, 1955-56

Type of conversion and tons normally crushed per day	Screw presses 1/	New investment: Total 2/	New investment: Per ton of daily crushing capacity	Annual crush required to yield: 5 percent	8 percent	10 percent	12 percent	15 percent	18 percent	20 percent
	Number	Dollars	Dollars	Tons	Tons	Tons	Tons	Tons	Tons	Tons
Screw press:										
150	4	265,600	1,770	13,400	16,100	17,900	19,500	22,500	25,200	27,000
140	4	247,400	1,768	11,200	13,600	15,200	17,600	19,200	21,600	23,200
130	3	229,300	1,764	12,000	14,500	16,100	17,700	20,200	22,700	24,400
120	3	211,200	1,760	10,100	12,100	13,600	14,900	17,000	19,100	20,500
110	3	193,100	1,755	8,500	10,200	11,400	12,500	14,300	16,100	17,200
100	3	175,000	1,750	7,100	8,600	9,500	11,000	11,900	13,400	14,400
90	2	156,900	1,743	7,500	9,100	10,100	11,100	12,700	14,200	15,200
80	2	138,700	1,734	6,000	7,200	8,000	8,800	10,200	11,300	12,100
70	2	120,600	1,723	4,700	5,700	6,400	7,000	7,900	8,900	9,500
60	2	102,500	1,708	3,700	4,400	4,900	5,400	6,100	6,900	7,300
50	1	84,400	1,687	4,000	4,800	5,300	5,800	6,600	7,400	7,900
Direct solvent 3/:										
150		529,000	3,527	18,500	22,200	24,800	27,200	31,000	34,700	37,200
140		509,000	3,636	17,900	21,300	23,700	26,000	29,600	33,100	35,500
130		489,000	3,762	17,000	20,400	22,700	25,000	28,500	31,900	34,200
120		469,000	3,908	16,400	19,500	21,600	23,800	27,000	30,300	--
110		449,000	4,082	15,600	18,700	20,800	22,900	26,000	--	--
100		429,000	4,290	14,900	17,900	19,900	21,900	25,000	--	--
90		409,000	4,544	14,000	16,800	18,700	20,500	23,500	--	--
80		389,000	4,863	13,400	16,000	17,900	19,600	--	--	--
Prepress solvent 3/										
150		495,000	3,300	15,900	19,000	21,100	23,200	26,400	29,500	31,500
140		479,000	3,421	15,400	18,500	20,400	22,500	25,500	28,500	30,500
130		463,000	3,562	14,900	17,900	19,900	21,800	24,800	27,600	29,600
120		447,000	3,725	14,500	17,400	19,200	21,100	24,000	26,800	28,700
110		431,000	3,918	14,000	16,700	18,500	20,400	23,200	26,000	27,900
100		415,000	4,150	13,600	16,300	18,000	19,800	22,400	25,100	--
90		399,000	4,433	13,200	15,800	17,500	19,200	21,800	--	--
80		383,000	4,788	12,700	15,200	16,900	18,500	21,000	--	--

1/ Based on table 17.
2/ From figure 3.
3/ Assuming no discount on meal.

Any specific tonnage of seed represents different amounts of business for mills of different sizes. If, for each mill size, this tonnage is expressed as representing a certain length of operating season, considerable regularity appears.

The mill for which the increase in revenue through conversion gives the higher rate of return on the new investment required may not be the one for which total net revenue gives the higher rate of return on total investment (figures 6 and 7). For returns on new investment through conversion, shown by length of seasons, see figure 8.

It is apparent from figure 8 that all of the conversions to solvent-extraction actually decreased the mill's net income if seed was available for only 3 months of operation. With $4\frac{1}{2}$ months' seed supply, the two smallest prepress-solvent conversions and the three smallest direct-solvent conversions still lost money for the management.

With continued lengthening of the season, the desirability of solvent conversion improved for all 5 mills, with prepress-solvent doing better than straight solvent conversion in each case. Moreover, the advantage of the prepress-solvent conversion increased both (1) from smaller to larger mills and (2) from shorter to longer season.

In a better position than either type of solvent conversion was screw-press conversion. Each size of mill, with each length of season, earned a better return on new investment through screw-press conversion than through solvent conversion. Rates earned on new investment for the three types of conversion, with a full 12-month operating season, ranged as follows:

Direct solvent	13.5% to 22%
Prepress solvent	15 % to 28%
Screw press	32 % to 54%

A clear difference between the situation with screw-press and solvent conversions is that the former showed the smaller mills, mostly, did better than the larger. As a generalization, the relationship surely holds true. Because of the relatively fixed size of screw presses and the great change in costs and in value of products with variation in throughputs, however, it is impossible to construct screw-press mills of certain sizes for good physical efficiency. The equipment of the mill simply is out of balance for the best operation.

For the study as a whole, it can be said there are few annual crushes under 18,000 tons for any hydraulic mill of under 150 tons per day for which conversion to either type of solvent mill will yield, after paying costs, as much as 10 percent on new investment. Within this size range, a conversion to modern (high speed) screw presses would attain the highest return per dollar of added investment. This return was estimated at about 30 cents for the average crush, of 25,000 tons, and as high as 50 cents for a crush of around 15,000 tons.

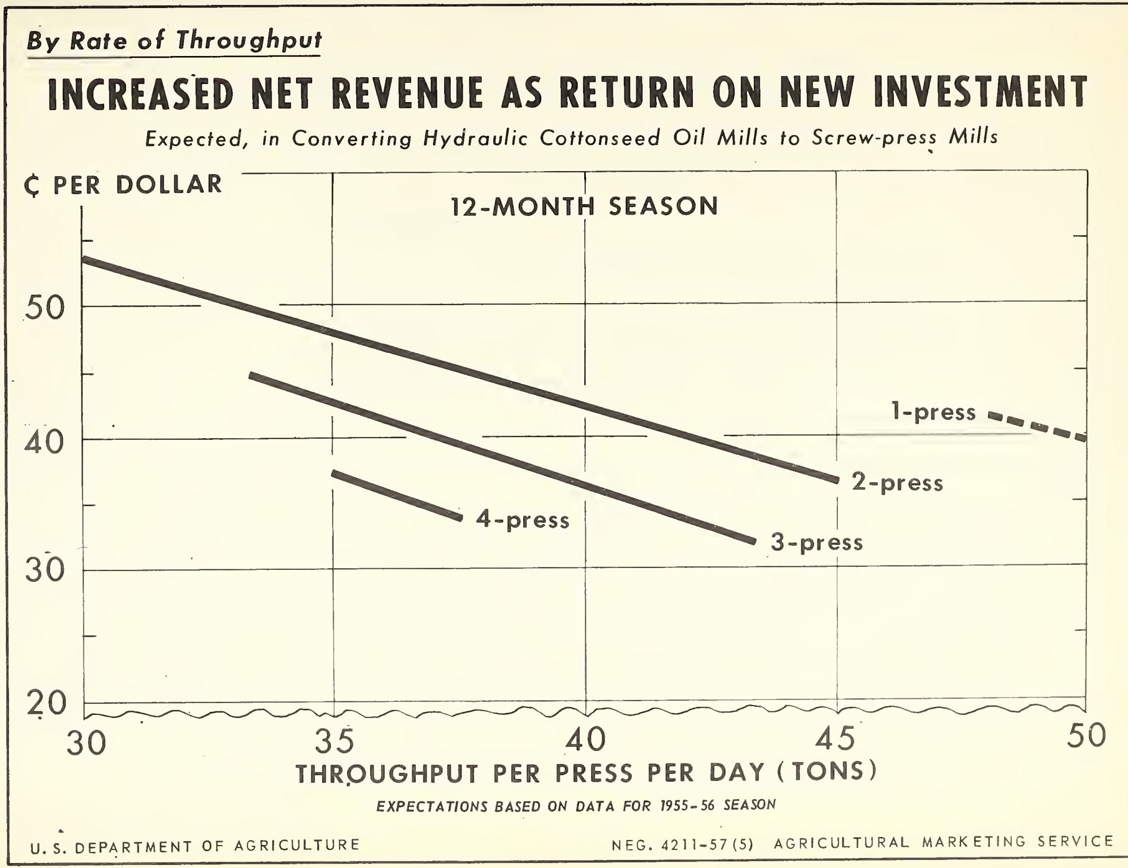
By Rate of Throughput
INCREASED NET REVENUE AS RETURN ON NEW INVESTMENT
Expected, in Converting Hydraulic Cottonseed Oil Mills to Screw-press Mills
¢ PER DOLLAR
12-MONTH SEASON
50
40
30
20
1-press
2-press
3-press
4-press
30
35
40
45
50
THROUGHPUT PER PRESS PER DAY (TONS)
EXPECTATIONS BASED ON DATA FOR 1955-56 SEASON
U. S. DEPARTMENT OF AGRICULTURE
NEG. 4211-57 (5) AGRICULTURAL MARKETING SERVICE

Figure 6

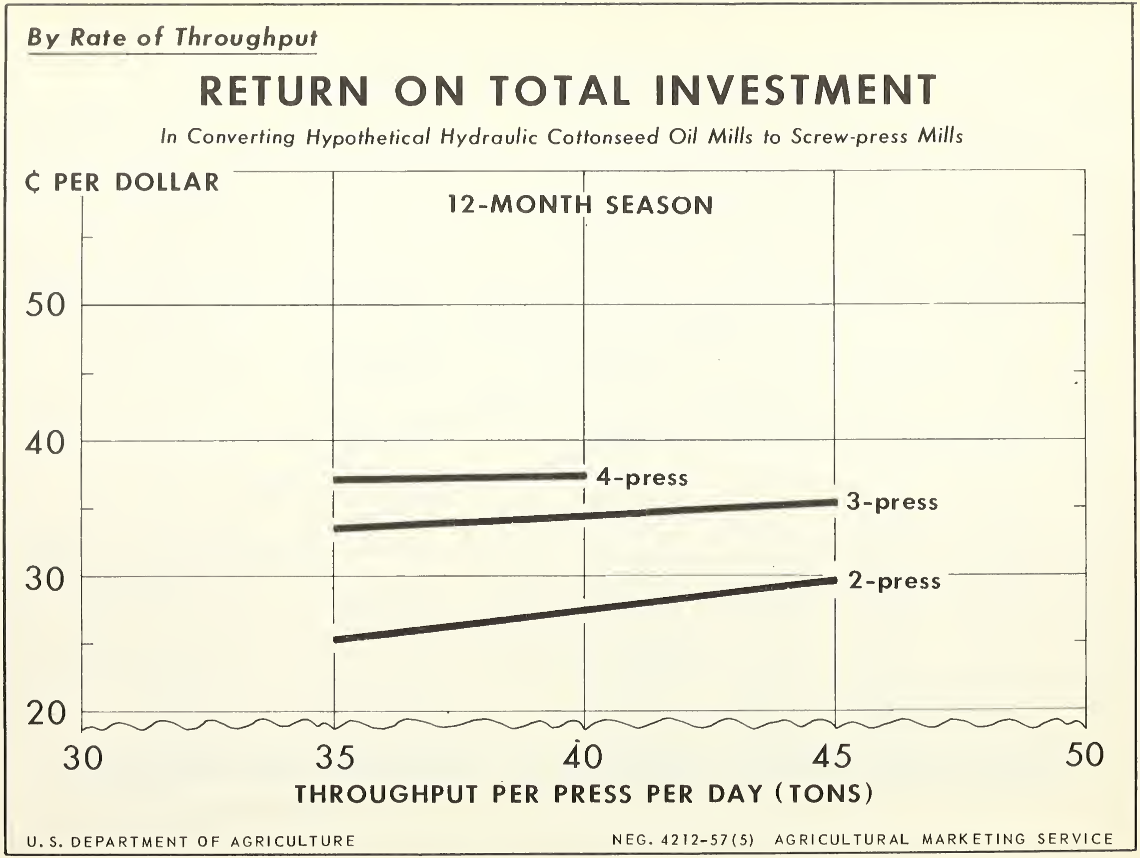
By Rate of Throughput
RETURN ON TOTAL INVESTMENT
In Converting Hypothetical Hydraulic Cottonseed Oil Mills to Screw-press Mills
¢ PER DOLLAR
12-MONTH SEASON
50
40
30
20
4-press
3-press
2-press
30
35
40
45
50
THROUGHPUT PER PRESS PER DAY (TONS)
U. S. DEPARTMENT OF AGRICULTURE
NEG. 4212-57(5) AGRICULTURAL MARKETING SERVICE

Figure 7

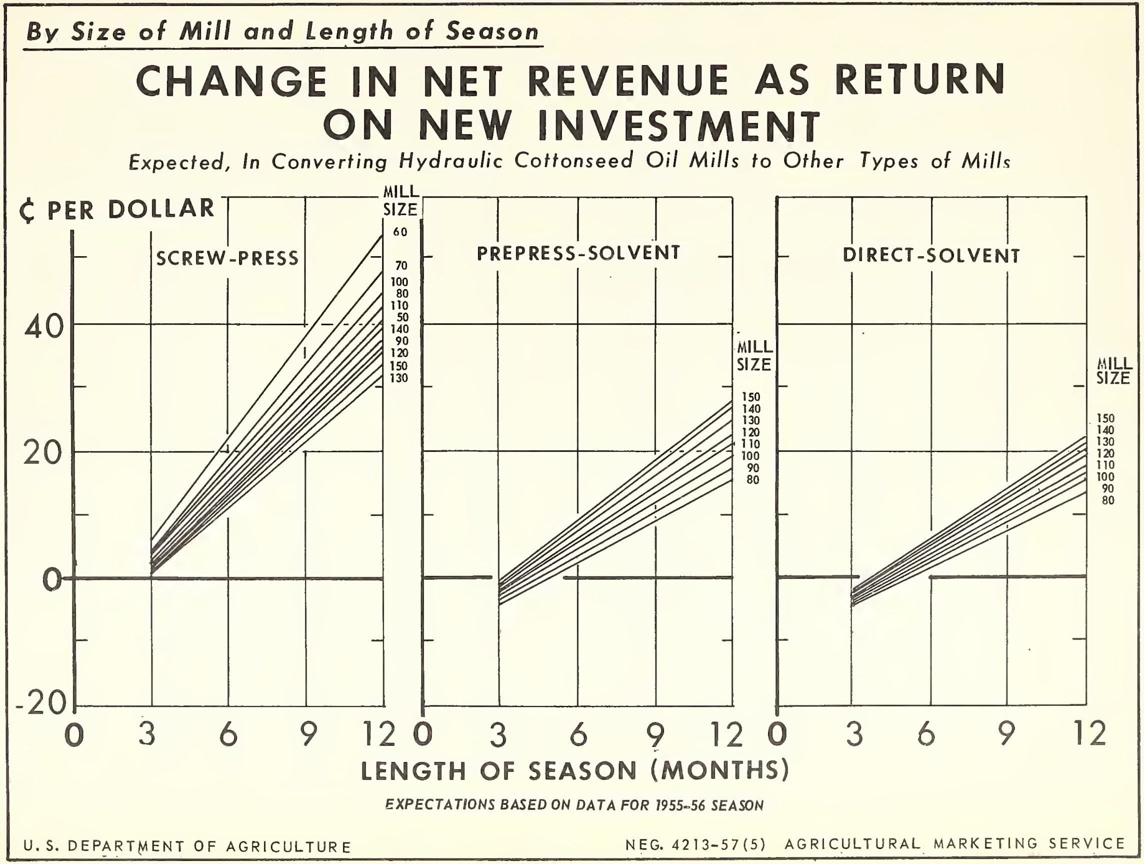
By Size of Mill and Length of Season
CHANGE IN NET REVENUE AS RETURN ON NEW INVESTMENT
Expected, In Converting Hydraulic Cottonseed Oil Mills to Other Types of Mills
¢ PER DOLLAR
SCREW-PRESS
PREPRESS-SOLVENT
DIRECT-SOLVENT
MILL SIZE
60
70
100
80
110
50
140
90
120
150
130
MILL SIZE
150
140
130
120
110
100
90
80
MILL SIZE
150
140
130
120
110
100
90
80
40
20
0
-20
0
3
6
9
12
LENGTH OF SEASON (MONTHS)
EXPECTATIONS BASED ON DATA FOR 1955-56 SEASON
U. S. DEPARTMENT OF AGRICULTURE
NEG. 4213-57(5) AGRICULTURAL MARKETING SERVICE

Figure 8

The conversion that yields the highest return per dollar of new investment may not be the conversion that reduces most the cost of processing cottonseed. It is the one, however, that will most improve the operator's competitive position in the industry and with other business opportunities.

APPENDIX I.--SCREW-PRESS THROUGHPUTS, OIL YIELDS, AND ELECTRIC POWER CONSUMPTION

Variation of Oil Yield With Screw-Press Throughputs

Modern screw presses are capable of operating over a wide range of throughputs. With motors loaded to approximately their rated capacity, at lower throughputs, screw presses use more electric power per ton of seed but they also extract more oil. Dunning has pointed out the continual lowering of residual oil in meal which has been achieved in recent years. 6/

For any given mill, a question thus arises as to the throughput per press at which the gain in oil yield and revenue is balanced by additional power consumption and investment costs. For example, if the mill capacity is 90 tons per day, would a greater profit per dollar of investment be achieved by installing 2 presses, each operating at 45 tons per day, or 3 presses, each operating at 30 tons per day? This question was handled by varying the number of presses for each mill and working out the corresponding gains (or losses) in (1) net revenues per ton of seed and (2) net returns per dollar of new investment.

To do this, it was necessary to estimate the relationship between press throughput, oil yield, and power consumption.

It was assumed that oil yield and residual oil in meal are directly related, though it is recognized that there is not always a perfect correspondence.

As numerous authorities have observed, various factors affect the residual oil left in meal by the screw press. 7/ These include the manner in which

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6/ Dunning, John W. Advances in High Capacity Expeller Operation. Oil Mill Gazetteer. 61 (2) August: 29-31. 1956.

7/ Burner, A. H. Fundamentals of Screw-Press Operations. Oil Mill Gazetteer. 60 (7) Jan.: 31-35. 1956.

__________ High quality Products from Screw Presses. Oil Mill Gazetteer. 59 (7) Jan.: 11-14. 1956.

Keahey, H. P. Screw Press Operation. Oil Mill Gazetteer. 58 (10) Apr.: 21-23. 1954.

Dunning, John W. High Capacity Expeller Operations. Oil Mill Gazetteer. 58 (12) June: 11-15. 1954.

the cottonseed meats are prepared, rolled, cooked, and pressed. To do an efficient job, a mill operator must have the right size and kind of equipment and know how to use it effectively.

Available Data

A considerable amount of data, both published and unpublished, is available on the operation of screw presses. However, not a great amount is available on the operation of what may be called "modern" screw presses. Modern presses are equipped and operated to turn out the highest yields of oil. Generally speaking, they are new installations, which means they were probably installed not earlier than 1954.

Average Relationship Between Press Throughputs and Oil Yields

Lines A and B in figure 9 show average relationships between throughputs and oil yield, reflecting earlier and later experience with modern screw-press operations.

Line A is the relationship derived from unpublished data from both major American manufacturers of screw presses.

Line C is the relationship from new data from the same sources (some of it published) 9 months later. This line reflects the continual improvement in screw presses which has been going on at a rapid rate in recent years.

Data from both sources, on which lines A and C are based, were in general agreement.

Two other sources of data presented information on throughputs and residual oil in meal from six mills. 8/ (It is possible that data on these mills may have been included in the information described above, from the manufacturers of screw presses, but they were considered separately because they came from different sources.) Observations on these six mills, plus observations from a private source, fell between lines A and C.

Line C may reflect more ideal operating conditions than would be normally experienced by the usual mill. Because of this possibility, line B was used in calculating oil yields from given rates of throughput. For example, based

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8/ Pryor, T. S. Improvements in Expeller and Screw Press Operations. Oil Mill Gazetteer. 61 (3) Sept.: 32-34. 1956.

Data on Cottonseed and Products and on Processing Conditions from Seven Mills Contributing Samples for the Oil Mill Operators' Short Course, A&M College of Texas, June 1956. Mimeographed unbound data sheets were given to registrants at the short course.

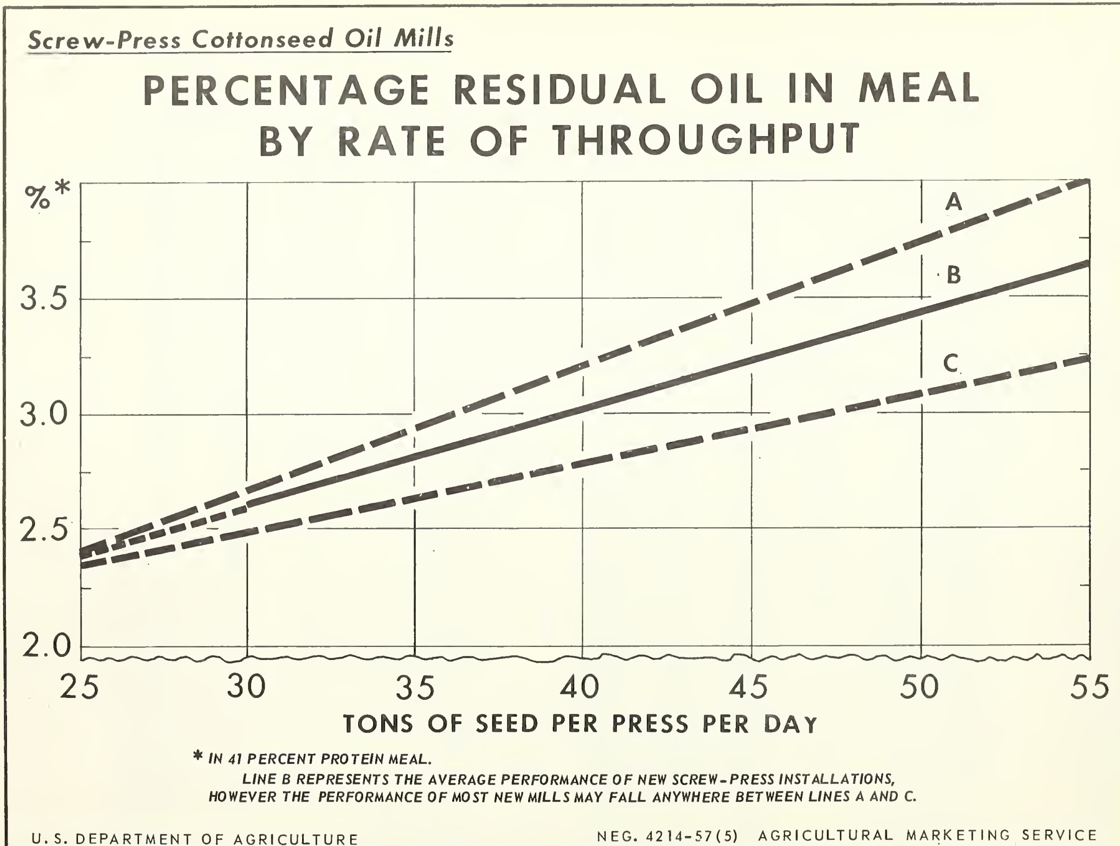
Screw-Press Cottonseed Oil Mills
PERCENTAGE RESIDUAL OIL IN MEAL
BY RATE OF THROUGHPUT
%*
3.5
3.0
2.5
2.0
A
B
C
25
30
35
40
45
50
55
TONS OF SEED PER PRESS PER DAY
* IN 41 PERCENT PROTEIN MEAL.
LINE B REPRESENTS THE AVERAGE PERFORMANCE OF NEW SCREW-PRESS INSTALLATIONS,
HOWEVER THE PERFORMANCE OF MOST NEW MILLS MAY FALL ANYWHERE BETWEEN LINES A AND C.
U. S. DEPARTMENT OF AGRICULTURE
NEG. 4214-57(5) AGRICULTURAL MARKETING SERVICE

Figure 9

on the average ammonia content (4.18 percent) of the seed processed by mills in this study, line B shows 3.20 percent residual oil in meal for a screw-press throughput of 45 tons per day and 2.60 percent for a throughput of 30 tons, equivalent to 31 and 26 pounds of residual oil in meal, assuming a meal yield of 982 pounds. The same principle applies to residual oils for any other press rates.

Original data, on which figure 9 is based, did not extend into the low range of throughputs less than 30 tons per day; consequently, line B was extrapolated to 25 tons per press per day.

Variation of Electric Power Consumption With Screw-Press Throughputs

Screw presses are equipped with either 1 or 2 motors totaling between 80 and 100 horsepower. If the input to a press were, say, 90 horsepower at all throughputs, kilowatt-hours consumed per ton of seed would be constant, as indicated by the smooth curve segment of the line in figure 10.

Below some rate of throughput (which varies with different operating conditions), screw-press motors cannot be maintained at full load because the excessive pressure would burn the meal and discolor the oil.

No precise measure of the variation of power consumption with screw-press throughput could be made from the data available. Figure 10 is the best estimate that could be made from information now at hand. The straight line segment of figure 10 was based on data from 4 mills. At the higher throughputs, represented by the curve segment, it was assumed that motors would be fully loaded.

APPENDIX II.--BREAKDOWN AND EXPLANATIONS OF NEW INVESTMENT IN CONVERTING 5 SPECIFIED HYDRAULIC COTTONSEED OIL MILLS INTO ALTERNATIVE TYPES OF MILLS

This appendix itemizes and explains the detailed breakdowns of new investment used in approximating the annual volumes of seed needed to support the new investment required to convert 5 specified hydraulic cottonseed oil mills into higher oil-yielding types of mills. The explanations are taken up in the order of the more profitable types of conversions: Screw-press, prepress-solvent, and direct-solvent.

Screw-Press Conversions

Table 21 breaks down the new investment needed for the screw-press conversions.

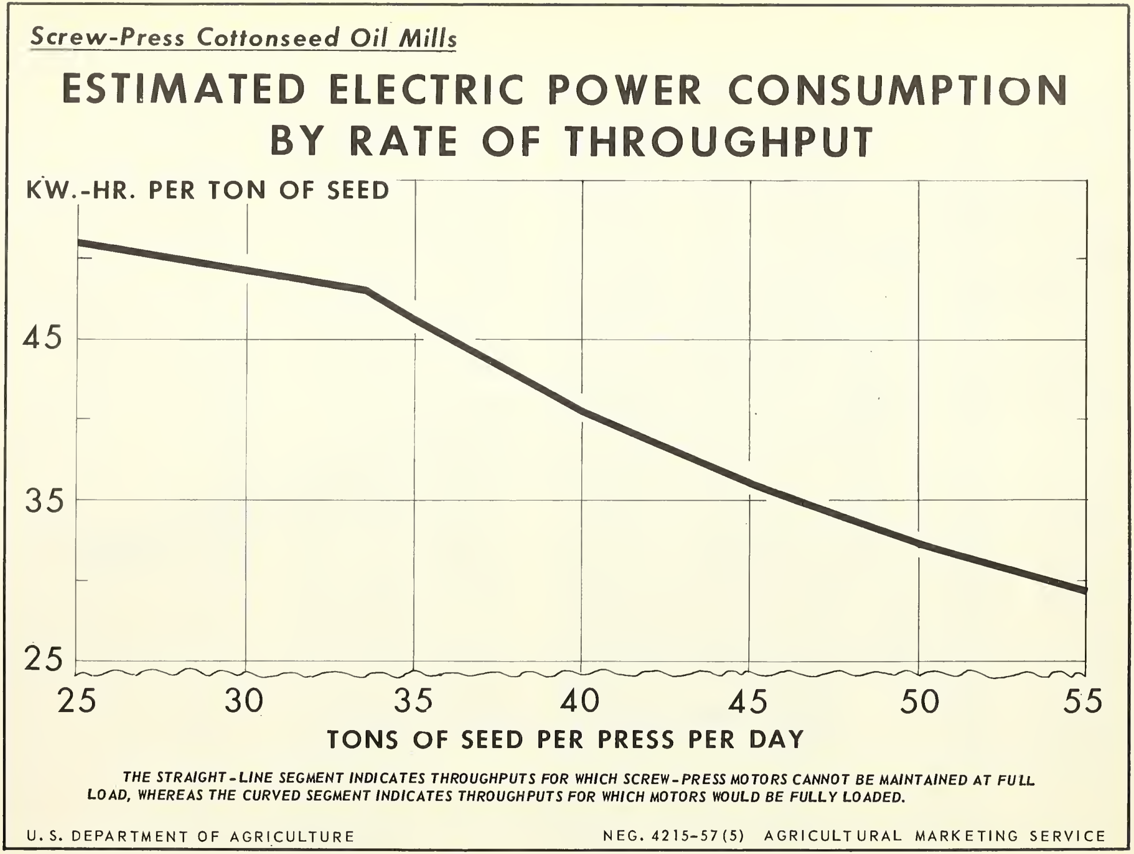
Screw-Press Cottonseed Oil Mills
ESTIMATED ELECTRIC POWER CONSUMPTION
BY RATE OF THROUGHPUT
KW.-HR. PER TON OF SEED
45
35
25
25
30
35
40
45
50
55
TONS OF SEED PER PRESS PER DAY
THE STRAIGHT-LINE SEGMENT INDICATES THROUGHPUTS FOR WHICH SCREW-PRESS MOTORS CANNOT BE MAINTAINED AT FULL LOAD, WHEREAS THE CURVED SEGMENT INDICATES THROUGHPUTS FOR WHICH MOTORS WOULD BE FULLY LOADED.
U. S. DEPARTMENT OF AGRICULTURE
NEG. 4215-57(5) AGRICULTURAL MARKETING SERVICE

Figure 10

Table 21.--Expected new investment and depreciation in converting 5 specified hydraulic cottonseed oil mills into modern screw-press mills, 1955-56 - Continued

Investment item	New investment: Materials and equipment	New investment: Instal- lation	New investment: Total	Per ton of daily crushing capacity	Expected years of useful life 1/	Depre- ciation as percentage of new investment	Annual depre- ciation
Mill C, 110 tons per day							
	Dollars	Dollars	Dollars	Dollars	Number	Percent	Dollars
Oil extraction department:							
Building modification	770	1,230	2,000	19	10	10.0	200
Screw presses and cookers:							
3 presses	94,190	22,920	117,110	1,065	25	4.0	4,684
4 presses	119,820	29,150	148,970	1,354	25	4.0	5,959
Other machinery	40,570	13,450	54,020	491	25	4.0	2,161
Connecting conveyor	4,490	1,520	6,010	55	25	4.0	240
Oil-handling equipment	12,680	3,240	15,920	145	25	4.0	637
Filter press, 36 inch	4,970	1,270	6,240	57	25	4.0	250
Auxiliary equipment	8,180	3,420	11,600	105	25	4.0	464
Miscellaneous machinery and materials	3,980	2,120	6,100	55	25	4.0	244
Rotary cake cooler	6,270	1,880	8,150	74	25	4.0	326
Portable fire extinguisher	500		500	5	10	10.0	50
Total conversion to--							
3-press mill	136,030	37,600	173,630	1,578	24	4.1	7,095
4-press mill	161,660	43,830	205,490	1,868	24	4.1	8,370
Mill D, 75 tons per day							
Oil extraction department:							
Building modifications	1,540	1,420	2,960	39	10	10.0	296
Screw presses and cookers:							
2 presses	71,160	17,090	88,250	1,177	25	4.0	3,530
3 presses	97,090	23,300	120,390	1,605	25	4.0	4,816
Other machinery	39,180	15,490	54,670	729	25	4.0	2,187
Connecting conveyor	4,990	1,520	6,510	87	25	4.0	260
Oil-handling equipment	9,690	2,550	12,240	163	25	4.0	490
Filter press, 36 inch	4,970	1,270	6,240	83	25	4.0	250
Auxiliary equipment	6,090	2,820	8,910	119	25	4.0	356
Miscellaneous machinery and materials	8,780	5,900	14,680	196	25	4.0	587
Rotary cake cooler	4,660	1,430	6,090	81	25	4.0	244
Machine shop	500	500	1,000	13	15	6.7	67
Total conversion to--							
2-press mill	112,380	34,500	146,880	1,958	24	4.1	6,080
3-press mill	138,310	40,710	179,020	2,387	24	4.1	7,366
Mill E, 50 tons per day							
Oil extraction department:							
Building modifications	310	1,160	1,470	29	10	10.0	147
Screw presses and cookers:							
1 press	39,430	9,680	49,110	982	25	4.0	1,964
2 presses	65,060	15,910	80,970	1,619	25	4.0	3,238
Other machinery	17,460	6,630	24,090	482	25	4.0	964
Connecting conveyor	4,490	1,520	6,010	120	25	4.0	240
Oil-handling equipment	4,410	1,580	5,990	120	25	4.0	240
Filter press, 24 inch	2,470	710	3,180	64	25	4.0	127
Auxiliary equipment	6,090	2,820	8,910	178	25	4.0	356
Portable fire extinguisher	500		500	10	10	10.0	50
Electric power supply	3,920	1,500	5,420	108	25	4.0	217
Total conversion to--							
1-press mill	61,620	18,970	80,590	1,612	24	4.1	3,341
2-press mill	87,250	25,200	112,450	2,249	24	4.1	4,615

1/ Based on data made available by Bureau of Internal Revenue.

Table 21.--Expected new investment and depreciation in converting 5 specified hydraulic cottonseed oil mills into modern screw-press mills, 1955-56

Investment item	New investment: Materials and equipment	New investment: Instal-lation	New investment: Total	New investment: Per ton of daily crushing capacity	Expected years of useful life 1/	Depre-ciation as percentage of new investment	Annual depre-ciation
Mill A, 150 tons per day							
	Dollars	Dollars	Dollars	Dollars	Number	Percent	Dollars
Oil extraction department:							
Screw press:							
4 presses	106,800	25,600	132,400	883	25	4.0	5,296
5 presses	133,500	32,000	165,500	1,103	25	4.0	6,620
6 presses	160,200	38,400	198,600	1,324	25	4.0	7,944
Other machinery	72,935	23,445	96,380	642	23	4.3	4,173
New cooker and accessories	20,550	5,510	26,060	174	25	4.0	1,042
Renovation of present cooker	2,650	2,650	5,300	35	10	10.0	530
Connecting conveyor	4,485	1,525	6,010	40	25	4.0	240
Oil handling equipment	12,680	3,240	15,920	106	25	4.0	637
Filter press, 42 inch	6,600	1,710	8,310	55	25	4.0	332
Auxiliary equipment	8,180	3,420	11,600	77	25	4.0	464
Miscellaneous machinery and materials	13,130	3,960	17,090	114	25	4.0	684
Rotary cake cooler	4,660	1,430	6,090	41	25	4.0	244
Total oil extraction department:							
4 presses	179,735	49,045	228,780	1,525	24	4.1	9,469
5 presses	206,435	55,445	261,880	1,745	24	4.1	10,793
6 presses	233,135	61,845	294,980	1,966	24	4.1	12,117
Boiler	12,730	5,080	17,810	119	25	4.0	712
Modification of present boiler building	2,710	4,750	7,460	50	10	10.0	746
Locker room building	6,155	4,495	10,650	70	40	2.5	266
Miscellaneous storage warehouse	4,250	2,950	7,200	48	40	2.5	180
Storeroom in existing building	550	550	1,100	7	40	2.5	28
Automatic sprinklers in screw-press department	1,400	--	1,400	9	10	10.0	140
Miscellaneous materials and equipment	3,970	--	3,970	26	25	4.0	159
Total conversion to--							
4-press mill	211,500	66,870	278,370	1,856	24	4.2	11,700
5-press mill	238,200	73,270	311,470	2,076	24	4.2	13,024
6-press mill	264,900	79,670	344,570	2,297	24	4.2	14,348
Mill B, 130 tons per day							
Oil extraction department:							
Building:							
3 presses	10,620	5,000	15,620	120	40	2.5	391
4 presses	11,880	5,520	17,400	134	40	2.5	435
5 presses	13,140	6,040	19,180	148	40	2.5	480
Screw presses and cookers:							
3 presses	116,390	27,980	144,370	1,111	25	4.0	5,775
4 presses	142,320	34,190	176,510	1,358	25	4.0	7,060
5 presses	168,250	46,610	214,860	1,653	25	4.0	8,594
Other machinery	41,370	15,890	57,260	440	25	4.0	2,291
Connecting conveyor	4,490	1,520	6,010	46	25	4.0	240
Oil-handling equipment	12,680	3,240	15,920	122	25	4.0	637
Filter press, 36 inch	4,970	1,270	6,240	48	25	4.0	250
Auxiliary equipment	8,180	3,420	11,600	89	25	4.0	464
Miscellaneous machinery and materials	6,390	5,010	11,400	88	25	4.0	456
Rotary cake cooler	4,660	1,430	6,090	47	25	4.0	244
Total oil extraction department:							
3 presses	168,380	48,870	217,250	1,671	26	3.9	8,457
4 presses	195,570	55,600	251,170	1,932	26	3.9	9,786
5 presses	222,760	68,540	291,300	2,241	26	3.9	11,365
Steam piping to screw-press department	800	1,330	2,130	16	25	4.0	85
Fire protection facilities	2,610	630	3,240	25	18	5.5	178
Fire hydrant and hose house	540	60	600	5	25	4.0	24
Automatic sprinklers in screw-press department	1,170		1,170	9	10	10.0	117
Water main	900	570	1,470	11	40	2.5	37
Total conversion to--							
3-press mill	171,790	50,830	222,620	1,712	26	3.9	8,720
4-press mill	198,980	57,560	256,540	1,973	26	3.9	10,049
5-press mill	226,170	70,500	296,670	2,282	26	3.9	11,628

See footnote at end of table.

Continued-

Mill A (150 tons per day)

The screw-press department of mill A was placed in an area of the present mill building and thus no new building was required. This arrangement also permitted utilization of the present rolls, meats bin, and cooker in their present positions, and allowed the use of the present engine room as a boiler house, for which this portion of the building was ideally suited. In the converted mill, it was planned to cook the rolled meats in the present cooker, convey them to a second cooker for drying and then to steam-jacketed conveyors or conditioners over each press for final heating just before they entered the presses. The screenings tank was in a pit in the floor. Broken screw-press cake was to be cooled by a rotary cooler before being conveyed to cake storage bins.

Utilization of present space to the best advantage for the screw-press process involved the removal of all present locker room facilities. New facilities were provided in a new building.

An old building is used at present for storing machinery and bulky supplies. Under all three conversion plans, this building would be removed. To take its place in the screw-press conversion, an addition to the building housing locker rooms was planned. This addition would be 32 feet wide and 50 feet long.

A small storeroom for miscellaneous items in the area needed for conversions would be removed, and a new storeroom established elsewhere in an existing building.

In contrast to the other mills, mill A shows an investment for a new boiler because the capacity of its present boiler was not enough to meet the additional steam requirements of a converted screw-press mill.

Mill B (130 tons per day)

The screw-press department for mill B was to be situated in a new building immediately adjacent to the meal department.

The building planned for the screw-press department would be of steel frame, ironclad, with rigid frame roof supports which give a maximum of head room. The building would be 32 feet wide, 80 feet long, and 20 feet from foundation to eaves, with the concrete floor 4 feet above the ground.

All of the machinery in the screw-press department would be new except the crushing rolls. The present rolls would be moved to the new location.

The cooking equipment was planned to be installed over the screw presses. The screening tank would be in a pit, along with an oil surge tank for the filter press, and oil pumps. A rotary cake cooker would cool the cake before it went to storage or grinding.

Mill C (110 tons per day)

Four screw presses could be fitted into the present pressroom if desired. The present rolls, rolled meats elevator, cooker, and cake elevator would be used in their present positions. The remaining equipment would be new.

New cooking equipment would be operated in series with the present cooker.

Building modifications would include removal of the present floor and of equipment under the present floor where necessary, new floor over part of the area of the pressroom, and other miscellaneous changes.

Auxiliary equipment would include principally dust and fume collection, electrical feeders and breakers, water cooling tower, and supporting steel.

Other machinery and materials would include items necessary to take care of differences between the original and converted mill designs, such as a second meats overflow bin and feeder for the second cooker.

The cake cooler would receive cake from the present bucket elevator, and the cake would be elevated from the cooler to the present bins.

Mill D (75 tons per day)

Three screw presses could be fitted into the present hydraulic pressroom.

The cookers would be mounted over the presses. In order to provide the head room necessary, the plan was to remove the present wooden floor and all foundations, tanks, and other installations under the floor of this section of the building. A new concrete floor would be installed a foot or so above ground level. All of the machinery would be new except the rolls, which would be the present ones.

Auxiliary equipment would include principally dust and fume collection equipment, electrical feeders and breakers, steam condensate collection tank, water cooling tower, and supporting steel.

Other machinery and materials included principally a new drive for the crushing rolls, reinstallation of crushing rolls, two screw elevators, some footage of screw conveyor, spouting, and reinstallation of the present cake breaker over the cooler.

Mill E (50 tons per day)

If desired, two presses could be placed in the mill building in the area occupied at present by hydraulic pressing.

The conversion plan was to cut out the wooden floor in this area in order to provide enough head room for the cooker to be mounted over the presses. The presses would be installed about 2 feet above ground level. A new concrete floor at ground level over this area would be necessary. Removal of present hydraulic presses, settling tanks, cooker, pumps, etc., would be necessary. Estimates of the removal of foundations, removal of wooden floor, installation of new floor, etc., are given in the table as "building modifications."

The present rolls and bucket elevator to the cooker would be utilized in their present positions. The present screw elevator, elevating cake to the conveyor, and the conveyor running to the meal department would be utilized. All other machinery in the pressroom would be new.

A new cooker was provided, to feed directly into the presses, because the present cooker would be inadequate.

In the long run of the conveyor to the meal department, sufficient cooling would occur to eliminate need of a cake cooler.

At present, all large motors in the mill run on power at 2,300 volts. For any conversion, a number of small motors would be added which would be better supplied at 440 volts. It was assumed, also, that screw-press motors would be run at 440 volts.

The power company would probably supply transformers for only one voltage. At present, the low voltage is 2,300 volts. Costs were estimated on the assumption that the mill would provide its own transformers to supply 440-volt power. This would be less expensive than converting the present 2,300-volt system to 440 volts.

Prepress-Solvent and Direct-Solvent Conversions

In studying the 75-ton-per-day hydraulic mill, it was found that neither direct-solvent nor prepress-solvent conversion would yield any added net revenue for an annual crush of less than 13,000 tons of seed. Therefore, this report does not carry investment requirements that would be needed for solvent conversions of mill E. Tables 22 and 23 show the expected requirements for converting the other four mills into prepress-solvent and direct-solvent mills.

Several prepress-solvent mills run press cake directly from the prepresses to the solvent extractor. This eliminates cake preparation equipment and flaking rolls. This practice was followed in this study for all prepress-solvent conversions.

Table 22.--Expected new investment and depreciation in converting 4 specified hydraulic cottonseed oil mills into prepress-solvent mills, 1955-56

Investment item	New investment: Materials and equipment	New investment: Installation	New investment: Total	Per ton of daily crushing capacity	Expected years of useful life 1/	Depreciation as percentage of new investment	Annual depreciation
	Mill A, 150 tons per day						
	Dollars	Dollars	Dollars	Dollars	Number	Percent	Dollars
Prepress department	79,120	21,930	101,050	673	23	4.3	4,360
2 prepresses	53,320	12,740	66,060	440	25	4.0	2,642
1 filter press, 36-inch	4,970	1,270	6,240	42	25	4.0	250
Oil-handling equipment	9,030	2,430	11,460	76	25	4.0	458
Conveyors and elevators	7,540	2,330	9,870	66	25	4.0	395
Auxiliary and miscellaneous equipment	1,610	510	2,120	14	25	4.0	85
Reconditioning of present cooker	2,650	2,650	5,300	35	10	10.0	530
Modification of present boiler building	2,510	4,410	6,920	46	10	10.0	692
Solvent extraction department	196,860	63,990	260,850	1,739	25	4.0	10,434
Facilities for soapstock addition to meal	11,000	3,600	14,600	97	25	4.0	584
2 meal screens, 2 hammer mills, conveyors and accessories	15,298	5,802	21,100	141	25	4.0	844
Boiler (200-hp.) and accessories	16,500	5,660	22,160	148	25	4.0	886
Modification of present engine room for use as boiler room	400	600	1,000	7	10	10.0	100
Remodeling of locker rooms	1,000	1,000	2,000	13	10	10.0	200
New storeroom in present boiler building	550	550	1,100	7	40	2.5	28
Fire protection facilities	33,260	9,210	42,470	282	20	4.9	2,086
Fire pump, 1,500 g. p. m.	11,180	3,190	14,370	96	25	4.0	575
Fire pump supply tank, 150,000 gal. capacity	6,930	3,260	10,190	68	40	2.5	255
Fire pump house	790	830	1,620	11	50	2.0	32
Sprinklers in prepress room	1,400		1,400	9	10	10.0	140
Sprinklers for solvent-extraction department	7,500		7,500	50	10	10.0	750
Water main	780	480	1,260	8	40	2.5	32
Safety tools	950		950	6	10	10.0	95
Solvent vapor detector	2,150	580	2,730	18	25	4.0	109
Water-solvent separation sump	1,580	870	2,450	16	25	4.0	98
Total conversion	356,498	116,752	473,250	3,155	23	4.3	20,214
	Mill B, 130 tons per day						
Prepress department	108,920	33,080	142,000	1,092	26	3.8	5,419
Building	11,880	5,520	17,400	.134	40	2.5	435
Machinery	97,040	27,560	124,600	958	25	4.0	4,984
Reinstallation of present rolls	60	3,050	3,110	24	25	4.0	124
2 prepresses and cookers	73,160	17,530	90,690	698	25	4.0	3,628
1 filter press, 36-inch	4,970	1,270	6,240	48	25	4.0	250
Oil-handling equipment	9,030	2,430	11,460	88	25	4.0	458
Conveyors and elevators	7,220	2,170	9,390	72	25	4.0	376
Auxiliary and miscellaneous equipment	2,600	1,110	3,710	29	25	4.0	148
Solvent extraction department	192,780	61,840	254,620	1,959	25	4.0	10,185
Facilities for soapstock addition to meal	11,000	3,600	14,600	112	25	4.0	584
2 meal screens, 2 hammer mills, conveyors and accessories	21,330	8,090	29,420	226	25	4.0	1,177
Steam supplies	5,210	4,360	9,570	74	25	4.0	383
Boiler accessories	2,550	840	3,390	26	25	4.0	136
Piping to oil extraction departments	2,660	3,520	6,180	48	25	4.0	247
Fire protection facilities	34,100	9,790	43,890	338	21	4.8	2,100
Fire pump, 1,500 g. p. m.	11,180	3,190	14,370	111	25	4.0	575
Fire pump supply tank, 150,000 gal. capacity	6,930	3,260	10,190	78	40	2.5	255
Fire pump house	790	830	1,620	12	50	2.0	32
Spray system for solvent-extraction department	7,500		7,500	58	10	10.0	750
Sprinklers in prepress room	1,000		1,000	8	10	10.0	100
Water main	1,480	1,000	2,480	19	40	2.5	62
Fire hydrant and hose house	540	60	600	5	25	4.0	24
Water-solvent separation sump	1,580	870	2,450	19	25	4.0	98
Safety tools	950		950	7	10	10.0	95
Solvent vapor detector	2,150	580	2,730	21	25	4.0	109
Additional land	1,000		1,000	8			
Total conversion	374,340	120,760	495,100	3,808	25	4.0	19,848

See footnote at end of table.

Continued-

Table 22.--Expected new investment and depreciation in converting 4 specified hydraulic cottonseed oil mills into prepress-solvent mills, 1955-56 - Continued

Investment item	New investment: Materials and equipment	New investment: Installation	New investment: Total	Per ton of daily crushing capacity	Expected years of useful life 1/	Depreciation as percentage of new investment	Annual depreciation
	Dollars	Dollars	Dollars	Dollars	Number	Percent	Dollars
Mill C, 110 tons per day							
Prepress department	75,740	20,490	96,230	875			3,968
Building modifications	770	1,230	2,000	18	10	10.0	200
Machinery	74,970	19,260	94,230	857			3,768
2 presses and cookers	53,160	12,040	65,200	593	25	4.0	2,608
Filter press, 24-inch	2,470	710	3,180	29	25	4.0	127
Oil-handling equipment	9,030	2,430	11,460	104	25	4.0	458
Connecting conveyor	4,880	1,630	6,510	59	25	4.0	260
Auxiliary and miscellaneous equipment	5,430	2,450	7,880	72	25	4.0	315
Solvent extraction department	192,340	62,340	254,680	2,315	25	4.0	10,187
Facilities for soapstock addition to meal	11,000	3,600	14,600	133	25	4.0	584
2 meal screens and hammer mills	12,280	4,580	16,860	153	25	4.0	674
Fire protection facilities	33,440	9,850	43,290	395			2,220
Fire pump, 1,500 g. p. m.	11,180	3,190	14,370	131	25	4.0	575
Fire pump house	790	830	1,620	15	50	2.0	32
Fire pump supply tank, 90,000 gal. capacity	4,100	3,100	7,200	65	40	2.5	180
Spray system for solvent-extraction department	7,650		7,650	70	10	10.0	765
Water main	1,710	1,150	2,860	26	40	2.5	72
6-inch indicator post valve	140	70	210	2	40	2.5	5
Hydrant and hose house	540	60	600	5	25	4.0	24
Water-solvent separation sump	1,580	870	2,450	22	25	4.0	98
Safety tools	950		950	9	10	10.0	95
Solvent vapor detector	2,150	580	2,730	25	25	4.0	109
Portable fire extinguishers	500		500	5	10	10.0	50
Sprinklers in control room	2,150		2,150	20	10	10.0	215
Additional land - 1.1 acres at $5,000 per acre	5,500		5,500	50			
Total conversion	330,300	100,860	431,160	3,920	24	4.1	17,633
Mill D, 75 tons per day							
Prepress department	57,300	16,520	73,820	984			3,131
Building modifications	1,540	1,420	2,960	39	10	10.0	296
Machinery	55,760	15,100	70,860	945			2,835
Prepress and cooker	39,730	9,660	49,390	659	25	4.0	1,976
Filter press, 36-inch	4,970	1,270	6,240	83	25	4.0	250
Oil-handling equipment	4,410	1,580	5,990	80	25	4.0	240
Conveyors and elevators	4,880	1,630	6,510	87	25	4.0	260
Auxiliary and miscellaneous	1,770	960	2,730	36	25	4.0	109
Solvent extraction department	162,960	51,620	214,580	2,861	25	4.0	8,583
Facilities for soapstock addition to meal	11,000	3,600	14,600	195	25	4.0	584
2 meal screens, hammer mills, and accessories	17,301	4,599	21,900	292	25	4.0	876
Fire protection facilities	30,800	9,320	40,120	536			1,832
Fire pump, 1,500 g. p. m.	11,180	3,190	14,370	192	25	4.0	575
Fire pump house	790	830	1,620	22	50	2.0	32
Fire pump supply tank, 150,000 gal. capacity	6,930	3,260	10,190	136	40	2.5	255
Spray system for solvent extraction department	6,300		6,300	84	10	10.0	630
Water main	920	590	1,510	20	40	2.5	38
Water-solvent separation sump	1,580	870	2,450	33	25	4.0	98
Safety tools	950		950	13	10	10.0	95
Solvent vapor detector	2,150	580	2,730	36	25	4.0	109
Linters warehouse	2,850	2,200	5,050	67	40	2.5	126
Machine shop	500	500	1,000	13	15	6.7	67
Total conversion	282,711	88,359	371,070	4,948	24	4.1	15,199

1/ Based on data made available by Bureau of Internal Revenue.

Table 23.--Expected new investment and depreciation in converting 4 specified hydraulic cottonseed oil mills into direct-solvent mills, 1955-56

Investment item	New investment: Materials and equipment	New investment: Instal-lation	New investment: Total	New investment: Per ton of daily crushing capacity	Expected years of useful life 1/	Depre-ciation as percentage of new investment	Annual depre-ciation
	Dollars	Dollars	Dollars	Dollars	Number	Percent	Dollars
Mill A, 150 tons per day							
Preparation machinery	35,270	10,310	45,580	304	25	4.0	1,823
Flaking rolls	30,620	7,160	37,780	252	25	4.0	1,511
Conditioner	2,650	2,650	5,300	35	25	4.0	212
Conveyors and others	2,000	500	2,500	17	25	4.0	100
Solvent extraction department	269,690	100,100	369,790	2,465	25	4.0	14,792
Facilities for soapstock addition to meal	11,000	3,600	14,600	97	25	4.0	584
2 meal screens, 2 hammer mills, conveyors and accessories	15,930	5,170	21,100	141	25	4.0	844
Boiler (300-hp.) and accessories	21,430	7,300	28,730	192	25	4.0	1,149
Modification of present engine room for use as a boiler room	400	600	1,000	7	10	10.0	100
Modification of present boiler building	500	2,500	3,000	20	10	10.0	300
Fire protection facilities	37,230	11,040	48,270	320			2,329
Fire pump, 2,000 g. p. m.	14,300	4,600	18,900	126	25	4.0	756
Fire pump supply tank, 150,000 gal. capacity	6,930	3,260	10,190	68	40	2.5	255
Fire pump house	1,190	1,250	2,440	16	50	2.0	49
Sprinklers for extraction department	9,350		9,350	62	10	10.0	935
Water main	780	480	1,260	8	40	2.5	32
Water-solvent separation sump	1,580	870	2,450	16	25	4.0	98
Safety tools	950		950	6	10	10.0	95
Solvent vapor detector	2,150	580	2,730	18	25	4.0	109
Total conversion	391,450	140,620	532,070	3,547	24	4.1	21,921
Mill B, 130 tons per day							
Preparation department	47,660	14,330	61,990	477			2,344
Building	6,490	2,590	9,080	70	40	2.5	227
Machinery	41,170	11,740	52,910	407	25	4.0	2,117
Conditioner	13,550	3,620	17,170	132	25	4.0	687
Flaking roll	27,620	8,120	35,740	275	25	4.0	1,430
Solvent extraction department	234,610	86,950	321,560	2,474	25	4.0	12,862
Facilities for soapstock addition to meal	11,000	3,600	14,600	112	25	4.0	584
2 meal screens, 2 hammer mills, conveyors and accessories	21,330	8,090	29,420	226	25	4.0	1,177
Steam supply	25,400	11,380	36,780	282			1,382
Building for boiler	4,470	1,440	5,910	45	40	2.5	148
Boiler (200-hp.) and accessories	18,040	6,320	24,360	187	25	4.0	974
Steam piping to extraction department	2,890	3,620	6,510	50	25	4.0	260
Fire protection facilities	34,600	9,790	44,390	341			2,150
Fire pump, 1,500 g. p. m.	11,180	3,190	14,370	111	25	4.0	575
Fire pump supply tank, 150,000 gal. capacity	6,930	3,260	10,190	78	40	2.5	255
Fire pump house	790	830	1,620	12	50	2.0	32
Spray system for extraction department	8,250		8,250	63	10	10.0	825
Water main	1,480	1,000	2,480	19	40	2.5	62
Water-solvent separation sump	1,580	870	2,450	19	25	4.0	98
Fire hydrant and hose house	540	60	600	5	25	4.0	24
Safety tools	950		950	7	10	10.0	95
Solvent vapor detector	2,150	580	2,730	21	25	4.0	109
Sprinklers for preparation department	750		750	6	10	10.0	75
Additional land	1,000		1,000	8			
Total conversion	375,600	134,140	509,740	3,921	25	4.0	20,499

See footnote at end of table.

Continued-

Table 23.--Expected new investment and depreciation in converting 4 specified hydraulic cottonseed oil mills into direct-solvent mills, 1955-56 - Continued

Investment item	New investment: Materials and equipment	Installation	Total	Per ton of daily crushing capacity	Expected years of useful life 1/	Depreciation as percentage of new investment	Annual depreciation
Mill C, 110 tons per day							
	Dollars	Dollars	Dollars	Dollars	Number	Percent	Dollars
Preparation department	21,690	8,630	30,320	275			1,110
Building	4,860	2,010	6,870	62	40	2.5	172
Machinery	16,830	6,620	23,450	213			938
Conditioner	1,520	3,040	4,560	41	25	4.0	182
Flaking roll	15,310	3,580	18,890	172	25	4.0	756
Solvent extraction department	214,930	82,490	297,420	2,704	25	4.0	11,897
Facilities for soapstock addition to meal	11,000	3,600	14,600	133	25	4.0	584
Meal screens and hammer mills	12,280	4,580	16,860	153	25	4.0	674
Fire protection facilities	33,440	9,850	43,290	395			2,211
Fire pump, 1,500 g. p. m.	11,180	3,190	14,370	131	25	4.0	575
Fire pump supply tank, 90,000 gal. capacity	4,100	3,100	7,200	65	40	2.5	180
Fire pump house	790	830	1,620	15	50	2.0	32
Spray system for extraction department	7,650		7,650	70	10	10.0	765
Water main	1,710	1,150	2,860	26	40	2.5	72
6-inch indicator post valve	140	70	210	2	40	2.5	5
Hydrant and hose house	540	60	600	5	40	2.5	15
Water-solvent separation sump	1,580	870	2,450	22	25	4.0	98
Safety tools	950		950	9	10	10.0	95
Solvent vapor detector	2,150	580	2,730	25	25	4.0	109
Portable fire extinguishers	500		500	5	10	10.0	50
Sprinklers in control room	2,150		2,150	20	10	10.0	215
Additional land - 1.1 acres at $5,000 per acre	5,500		5,500	50			
Total conversion	298,840	109,150	407,990	3,709	25	4.0	16,476
Mill D, 75 tons per day							
Preparation department	17,600	6,140	23,740	316			935
Building modifications	500	500	1,000	13	40	2.5	25
Machinery	17,100	5,640	22,740	303			910
Flaking roll	15,310	3,580	18,890	252	25	4.0	756
Conditioner and conveyor	1,790	2,060	3,850	51	25	4.0	154
Solvent extraction department	205,980	78,230	284,210	3,789	25	4.0	11,368
Facilities for soapstock addition to meal	11,000	3,600	14,600	195	25	4.0	584
2 meal screens, hammer mills and accessories	15,987	5,913	21,900	292	25	4.0	876
Fire protection facilities	32,300	9,320	41,620	556			1,982
Fire pump, 1,500 g. p. m.	11,180	3,190	14,370	192	25	4.0	575
Fire pump supply tank, 150,000 gal. capacity	6,930	3,260	10,190	136	40	2.5	255
Fire pump house	790	830	1,620	22	50	2.0	32
Spray system for extraction department	7,800		7,800	104	10	10.0	780
Water main	920	590	1,510	20	40	2.5	38
Water-solvent separation sump	1,580	870	2,450	33	25	4.0	98
Safety tools	950		950	13	10	10.0	95
Solvent vapor detector	2,150	580	2,730	36	25	4.0	109
Linters warehouse 2/	2,850	2,200	5,050	67	40	2.5	126
Machine shop 2/	500	500	1,000	13	15	6.7	67
Total conversion	286,217	105,903	392,120	5,228	24	4.1	15,938

1/ Based on data made available by Bureau of Internal Revenue.
2/ Present linter warehouse removed to provide site for solvent extraction unit and new warehouse of the same type provided in a different location.

Mill A (150 tons per day)

The prepress department was to be placed in an area of the present mill building as planned for the screw-press conversion also. The present cooker in the present location would cook meats for prepressing in two screw presses. Each press was provided with a steam-jacketed conveyor section ahead of the press to reheat the meats, if necessary, after they had been conveyed from the present cooker. For housing prepress departments, the costs of modifications for the present building were estimated as shown in table 22.

For all 4 mills, the solvent extraction department for either the direct-solvent or prepress-solvent process was to be located at least 50 feet from the preparation building and control room and at least 100 feet from all other structures in order to reduce fire and explosion hazards, in line with requirements for minimum insurance rates.

The costs for the extraction departments were estimated for unhoused equipment. The equipment commonly is used either way, housed or unhoused, with varying factors entering into the preferences. Extraction units are priced on a "package" basis so that a breakdown of the total cost for this department was not possible. Items necessary for a complete installation, however, include the following:

1. Solvent-extraction, oil- and meal-desolventizing, and accessory equipment.
2. Insulation for equipment.
3. Concrete foundations and paved area around the equipment.
4. Electric power supply, motors, controls, and wiring.
5. Lighting for the extraction area.
6. Small building near the extraction department to house electric controls and instruments and to provide shelter for the operators.
7. Conveyors supplying flakes to the extractor and returning extracted meal to the meal bins.
8. Supports for conveyors and piping between the preparation department and the extraction department.
9. Cooling tower, pumps, and piping to cool and recirculate condenser water.
10. Refrigeration system to supply chilled water to the condenser into which run the vent lines for solvent vapor.

11. Meal coolers.

12. Solvent storage tank or tanks, with solvent unloading pump and piping.

13. Piping, including steam, condensate, and oil lines between the solvent-extraction department and the preparation department.

14. Instruments and flame arrestors.

15. Fence enclosing the extraction department and solvent-storage tanks.

16. Railroad siding on which to spot solvent cars for unloading.

17. Site preparation.

In both solvent processes, meal is screened to remove "fines," and the oversize particles are ground by hammer mill. Two screens and two hammer mills were provided for mill A for this purpose. Grinding and screening facilities were provided sufficient to process in 12 hours or less the meal produced in 24 hours for both types of solvent conversions of mills B, C, and D, as well as mill A.

The meal cooler was to be located in the meal processing department but the cost of the cooler was included in the costs of solvent extraction departments.

Some mills add soapstock to the meal as it comes from the solvent plant. Others add soapstock to meal before bagging or pelleting; different amounts being added to meal and pellets. Because the point of addition and the amount added vary from mill to mill, no particular plan for the addition of soapstock was used in this study. Instead, an allowance of $14,600 was made for soapstock facilities. This amount was deemed sufficient to cover any reasonable plan that might be desired.

The present boiler of mill A would not be adequate for either the direct-solvent or prepress-solvent conversions. A 200-horsepower, automatically fired boiler, using No. 6 fuel oil, was provided for the prepress-solvent conversion, whereas a 300-horsepower boiler was provided for the direct-solvent.

For the solvent-extraction departments of both direct- and prepress-solvent conversions of mill A, deluge sprinkler systems with control valves were provided. Also there were provided a fire pump with electric motor and automatic controls, a fire pump house, and a 150,000-gallon ground-level water supply tank, as well as spark-proof tools and a catch basin to separate solvent from water.

Mill B (130 tons per day)

The prepress department for mill B was to be located in a new building. The building would be of steel frame, iron-clad, and have the same dimensions as the screw-press building, 32' x 80' x 20'.

All of the equipment in the prepress department would be new except the crushing rolls. The present rolls would be moved to the new location.

Explanations of the solvent-extraction department for mill A apply to mill B.

Boiler accessories included a water softener and a feed water heater to be used with the present boiler.

The items under fire protection facilities appear self-explanatory.

Mill C (110 tons per day)

The plan was for the prepress department of mill C to be laid out and situated in a manner similar to the screw-press department.

The solvent-extraction department would have to be situated on new land at one end of the present property. The plan was to convey prepress cake by screw conveyor on a trestle from the prepress department to the solvent department, and for the extracted cake to be cooled and then conveyed back on the trestle to the present cake bins. From the bins the cake would be ground and screened as needed for bagging or shipping in bulk. The only new machinery would be meal screens and hammer mills. They were planned to be installed in the present meal room.

Facilities for soapstock addition to meal were provided.

The same description of items covered under cost for the solvent-extraction department for mill A also apply to mill C with the exception of conveyor and trestle. Because of the remote location of this department from the rest of mill C, the additional conveyor and trestle were needed to and from this department and the main mill building.

Mill D (75 tons per day)

The prepress department plan for mill D was essentially the same as for the screw-press department described above. The principal difference was that there were fewer screw presses and no cake cooler.

Explanations of the costs of the solvent extraction unit for mills A, B, and C also apply to mill D.

Items under fire protection facilities are self-explanatory.

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF FIGURES

LIST OF FIGURES (Continued)

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